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ACTIVITIES OF THE UNITED NATIONS SYSTEM IN THE FIELD OF WATER AND MINERAL RESOURCES, AND INTER-AGENCY COORDINATION FOCUSING ON PROGRESS MADE TOWARDS ACHIEVING SUSTAINABLE DEVELOPMENT

Activities of the Economic and Social Commission for Asia and the Pacific in the areas of water and mineral resources

Note by the Secretary-General

The report of the Economic and Social Commission for Asia and the Pacific (ESCAP) on its activities in the fields of water and mineral resources and identification of new and future uses to which remote-sensing technology and data sets can be applied in the mineral and water sectors in Asia and the Pacific, available in the language of submission, is contained in the annex below.

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Annex

REPORT OF THE ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC IN THE AREAS OF WATER AND MINERAL RESOURCES

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I. ACTIVITIES OF ESCAP IN THE FIELD OF WATER RESOURCES

Introduction

1. The Asian and Pacific Region, excepting the extreme north, is more densely populated and intensively calculated than elsewhere in the world, with 60 per cent of the world's population and 60 per cent of the total irrigated land. The region's share of the global water resources is about 30 per cent of the total.

2. In the last two decades there has been growing pressure on water resources with increasing demand from all sectors, in line with the population increases, agricultural expansion, industrial development, and with increasing pollution of water bodies.

3. On the other hand, the ESCAP region is widely subjected to vagaries of natural hazards, effects of which are significantly amplified due to extensive human activities at vulnerable areas. Floods are the most frequently occurring hazard in the region, with almost all of the countries experiencing frequent and severe flooding.

4. Accordingly, the work of the ESCAP secretariat in the field of water resources has been oriented towards assisting the Governments of the region in the formulation of implementation of plans and programmes for integrated water resources development and management within the context of national economic and social development plans and in the protection of water resources and aquatic ecosystems, for sustainable development. The work programme is formulated in accordance with imperatives of the Mar del Plata Action Plan, the related provisions of Agenda 21, World Conference on Natural Disaster Reduction (Plan of Action), and relevant Commission and Committee resolutions.

5. In line with the given mandates, ESCAP undertakes studies on assessment of the water resources and water uses of the member countries,

and provides assistance in formulation of activities on provision of water supplies for rural development and sustainable development, with emphasis on demand management. Activities on natural disaster reduction, particularly on flood loss prevention form an integral part of the work.

6. In implementation of its work programme in the field of water resources, ESCAP undertakes studies, organizes expert group meetings, workshops, seminars provides advisory services, prepares issue papers for the consideration of the Commission and ESCAP Committee on Environment and Sustainable Development, and maintains liaison with other United Nations and non-U.N. agencies dealing with water resources. ESCAP also publishes and disseminates quarterly bulletins of the *Water Resources Journal* and semi-annual issues of *Confluence*, as well as the widely-known *Water Resources Series* and other publications.

7. The recent activities of ESCAP undertaken in the field of water resources are summarized in the following paragraphs.

A. Integrated water resources development and management

8. An important activity undertaken recently to promote integrated water resources development and management in the region was an expert meeting on the implications of Agenda 21 for integrated water management in Asia and the Pacific held in Bangkok in September 1995.

9. The objective of the Meeting, which was jointly implemented with UNEP, was to assist the developing countries and the disadvantaged economies in transition in the Asian-Pacific region in the formulation and implementation of strategies and policies for integrated of water resources within the context of national social and economic planning efforts, which were to be consistent with the relevant provisions of Agenda 21, a programme of action for sustainable development, adopted by the United Nations Conference on Environment and Development held at Rio de Janeiro in 1992.

10. One of the activities currently under implementation by ESCAP to enhance sustainable water development and management is the establishment of water pricing policies and structures in the region. The project is being carried out in two phases: Phase I to conduct studies on the existing water pricing policies and structures in the region and Phase II to prepare appropriate water pricing policies and structures suitable to countries in the region.

11. The secretariat has prepared issue papers for consideration of the Commission and ESCAP Committee on Environment and Sustainable Development on efficient water resources management for sustainable development in the region and on flood loss mitigation through land-use planning and management. ESCAP has also provided advisory services on various aspects of integrated water resources development and management to Bangladesh, Brunei, Cambodia, China, Nepal, Philippines, Sri Lanka, Uzbekistan and Vanuatu.

B. Water resources assessment

12. The secretariat has conducted studies and published a series of monographs on the assessment of water resources and water demands by user sectors in various countries: Thailand, Japan, Myanmar (in print), China (in preparation). It has also completed a Guidebook to the Water Resources, Use and Management in Asia and the Pacific. This Guidebook is intended to provide succinct information on the water resources availability, water development structures, water use and water demand projections etc. of countries in the ESCAP region, which is expected to be useful for planners, policy makers and others concerned with water resources.

13. Workshops and training courses on water resources assessment have been organized to assist countries in their national capacity building in this field, including a workshop on computer applications in groundwater development and management organized in 1993 with the collaboration of United Nations DDSMS. Advisory services on water resources assessment were provided to Iran, Mongolia, and the Philippines.

C. Protection of water resources, water quality and aquatic ecosystems

14. ESCAP conducted a study on the current status of protection of water resources, water quality and aquatic ecosystems in the region which was endorsed at an expert group meeting in October 1994. Based on the deliberations of this expert group a publication containing guidelines on the protection of water resources as well as the experience of selected countries in this field has been prepared which will be published in the second half of 1995. The expert group made recommendations for promotion of undertaking of studies to determine the economic costs associated with water quality and quantity problems in the region, with the objective of determining the extent of freshwater crisis, and as a basis for developing a regional and a global action plan for averting a freshwater crisis in the next century.

15. In addition to the above activity, ESCAP jointly with UNESCO and Asian Institute of Technology organized a training course on assessment and reduction of groundwater contamination in 1994.

D. Drinking water supply and sanitation

16. During the 1994-1995 biennium the secretariat has implemented the training component of the World Bank/UNDP project on the rehabilitation of water utilities of Phnom Penh and Sihanoukville in Cambodia. Under this training programme a large number of national staff at various levels (from director level to technician level) have been trained in the fields of management, accounting, water resources planning and development, operation and maintenance of water utilities, water treatment and distribution etc., at various institutions abroad as well as within. Advisory services on drinking water supply were provided to Azerbaijan and Uzbekistan.

17. ESCAP is currently implementing an activity on the preparation of a guidebook on promotion of investments for water supply and sanitation projects to assist the developing countries and countries with the economies in transition in mobilizing financial resources from the private sector and financial institutions for developing infrastructure in this sector.

E. Water for sustainable urban development

18. Studies were carried out by ESCAP on the integrated approach to efficient development, management and use of urban water resources which were considered and endorsed at the regional seminar on water management in urban areas held in Bangkok in March 1993. The seminar stressed the urgent need for action at the national and international levels aimed at achieving adequate sustainable urban water supplies and the conservation and protection from pollution of water resources in urban areas. However, it was noted that although the need for properly managed urban water resources was recognized in the region, policies for sustainable development and environmentally sound management of water resources in urban areas had largely failed to materialize in many countries. A number of other workshops and seminars on urban water management were

also organized in Azerbaijan, Kazakhstan, Kyrgyzstan, Myanmar, Turkmenistan, Uzbekistan and Viet Nam between 1993 and 1995.

F. Disaster prevention and mitigation

19. During the period 1992-1995, water-related natural disaster reduction activities have been carried out by ESCAP with the aim of strengthening the disaster preparedness and mitigation capabilities of member countries through provision of technical assistance and training of key personnel in various aspects of natural hazard reduction; and for strengthening or introducing institutional frameworks for natural disaster preparedness and mitigation; promotion of regional cooperation in natural disaster reduction; and provision of substantive support to such intergovernmental institutions as the Typhoon Committee and the Panel on Tropical Cyclones. The secretariat also prepared an issue paper on natural disaster reduction for the consideration of the Commission, which accorded high priority activities in this field.

20. During the bienniums 1992-1993 and 1994-1995 ESCAP conducted seminars on comprehensive flood loss prevention and management and provided consultancy/advisory services on water-related natural disaster reduction in Nepal, Myanmar, Pakistan, Islamic Republic of Iran, Solomon Islands, Fiji, Samoa, India, Cambodia, Vanuatu and Viet Nam. The ESCAP publication *Manual and Guidelines for Comprehensive Flood Loss Prevention and Management* which was used in these seminars, have been widely distributed in the region. The Governments of China and the Republic of Korea had this publication translated into their national languages for nationwide use. A recent publication, *Natural Hazards and Natural Disaster Reduction in Asia and the Pacific*, reviewing the natural hazards affecting the region and the responses undertaken by the countries, is under reproduction. ESCAP also actively participated in the organization of the World Conference on IDNDR in 1994, and presented a review paper on natural disasters in Asia.

G. TCDC activities and other support

21. The ESCAP secretariat assisted developing countries in training their national experts in the above six areas in the water sector through its TCDC training programme. During the reporting period Cambodia, China, Iran, Kazakhstan, Kyrgyzstan, Malaysia, Myanmar, Philippines, Tajikistan, Thailand, Turkmenistan and Uzbekistan participated in the TCDC activities.

H. Coordination and liaison with other United Nations agencies

22. As regards to coordination with other United Nations agencies at the regional level, ESCAP has continued to serve as the secretariat of the Interagency Task Force on Water for Asia and the Pacific, which has recently been transformed into the RICAP (Regional Interagency Committee for Asia and the Pacific) Subcommittee on Water Resources, and hosted two sessions annually. At these sessions representatives of

agencies exchanged information and discussed how to collaborate and complement each other's work programme to enhance synergy, and eliminate duplication. As a result, most of ESCAP activities in the field of water resources were carried out in collaboration with other United Nations bodies and specialized agencies.

23. ESCAP continued to maintain its close contact and cooperation with WMO in providing substantive support to the work programmes and annual sessions of the Typhoon Committee and the Panel on Tropical Cyclones. ESCAP has continued its traditional support to the Mekong River Commission and maintained its strong relations with the IDNDR Secretariat.

24. ESCAP actively participated in the activities organized by other United Nations bodies and specialized agencies and in return received considerable support in holding of its own workshops and seminars.

II. ACTIVITIES OF ESCAP IN THE FIELD OF MINERAL RESOURCES

Introduction

25. The countries of the Asia-Pacific region has shown a great awareness for development of their mineral resources during the past decade and such activities are now recognized as a vital engine of growth for economic progress.

26. The increase in population in the region coupled with significant economic progress which will continue upto the 21st century will thus expand the supply of minerals for industry within the region.

27. Accordingly, the work of the ESCAP secretariat in the field of mineral resources has been oriented towards assisting Governments of the region in the formulation and implementation of plans and programmes for integrated mineral resources development and management within the context of national economic and social development policies that strives to achieve sustainable development.

A. Mineral resources base and its development in the region

28. Most of the countries in the region have also realized that there should be an expansion of foreign direct investment in the mineral sector as such activity entails venture capital and transfer of technology. Accordingly, the ESCAP secretariat has promoted activities in formulation of appropriate mineral development strategies conducive to foreign investment. To this end, the reorientation of national mineral policies involving legal and fiscal regimes that are attractive to the foreign investor have been vigorously pursued. The ESCAP secretariat have thus provided consultancy services for the review of mining codes and related investment regimes in Cambodia, Bhutan, Kazakhstan, Kyrgyzstan, Myanmar, Sri Lanka and Viet Nam. Such services also focussed on the process of national policy reorientation, mineral potential evaluation, formulation

of project proposals and assistance in negotiations related to mineral investment agreements. In realization of the important role the ESCAP secretariat could play in catalyzing foreign direct investment in the mineral sector, a Regional Advisor on Mineral Policy and Mineral Economics was recruited in August 1995 and continued advise in this sector is now being provided for countries requesting for such services.

B. Investment promotion in the mining sector

29. The ESCAP secretariat has also recognized the importance of promoting mineral investment at the sub-regional/regional level in response to efforts by various sub-regional groupings (growth triangles) in promoting economic growth. To achieve this objective, two mineral investment oriented projects, namely, review of mineral policies for development of the mining industry and investment promotion in selected countries of the Asia-Pacific region and training on negotiating mineral investment agreements in Asian LDC's and South Pacific island states were formulated for extra-budgetary funding from bilateral donors.

C. Environmental management of mineral resources

30. The ESCAP secretariat also focussed its activities on the assessment of geological and mineral resource potential and policy for development in Asian least developed countries and on subregional/regional assessment of important mineral commodities such as gold, base metals, industrial and non-metallic minerals and construction materials. The issues related to environmental management of mineral resources development were also pursued, and to this end, two regional studies on exploitation and use of mineral waste and confinement of waste in underground space have been carried out. The findings of these studies will be contained in a publication on mineral recovery, recycling, waste prevention and confinement for sustainable development in the Asia-Pacific region which will be released shortly.

D. Sustainable development of mineral resources

31. Sustainable development will not be achieved if key factors such as poverty alleviation and population control are not effectively addressed. To this end, sustainable mineral resource development will contribute to eradication of poverty as well as economic progress by increased exports of mineral commodities as well as downstream secondary and tertiary processing to produce finished industrial products. Accordingly, the activities related to mineral resources development by the ESCAP secretariat will catalyze sustainable development specially in the countries with reasonable endowments of minerals in the Asia Pacific region.

32. The publications of the ESCAP secretariat related to geology and mineral resources assessment as well as those containing studies on minerals trade, legal and investment regimes including environmental management continued to be in strong

demand by the world geological and mining community and such dissemination of information has also catalyzed foreign direct investment (FDI) in the mineral sector.

E. Geology in land use planning and management

33. The application of geological principles for land-use planning and environmental geology is becoming increasingly important in the Asia-Pacific region mainly due to rapidly expanding urban centres as well as increased mining activity centered around human habitations. To this end, the ESCAP secretariat is actively involved in compilation and issuance of a series of urban and environmental geology maps. Two regional expert group meetings and training activities through the implementation of a project on Environmental and Urban Geology for Sustainable Development of Fast-growing Cities were also carried out. In this regard it must be stated that the activities of the ESCAP secretariat have been highly successful in creating an awareness among urban planners as well as decision makers in the member countries on the importance of geoscientific knowledge in the urban planning process. Geohazards of both natural and man-made have also been given considerable importance in all development activities within the region and the assessment of such hazards is also within the work programme.

F. Marine affairs and marine minerals

34. The importance of marine affairs in the national planning process of the countries in the region has increased during the last two years and could be related to the entry into force of the 1982 United Nations Convention on the Law of the Sea on 16 November 1994. Moreover, Chapter 17 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED) held in Reo de Janeiro in 1992 has stressed the importance of the protection and sustainable development of the marine and coastal environment and its resources. Accordingly, the ESCAP secretariat has been actively involved in the study of integrated coastal zone management and practices in the Asia Pacific region and assessment of mineral and petroleum potential in the coastal and offshore areas of North-East Asia and these studies will be published shortly.

35. The ESCAP secretariat also actively pursued training activities related to legal, technical and financial aspects for removal of obsolete offshore installations and platforms on the Exclusive Economic Zone and the Continental Shelf of the Asia-Pacific region with the conduction of the third seminar in September 1995 and such activity will be pursued during 1996 where it is expected to hold a final forth seminar with extrabudgetary financial resources.

36. Ongoing and future activities related to marine affairs by the ESCAP secretariat will focus on providing necessary guidance to member states in the integration of their marine related policies with the United Nations Convention on the Law of the Sea and thus harmonizing with such international practices so as to achieve universalization.

37. The above activities have contributed to the improvement of capabilities of key mineral and marine sector institutions in assessment of the mineral potential including

offshore minerals, integrated land use planning including coastal zones, realization of the rights and obligations under universal laws and conventions such as the 1982 United Nations Convention on the Law of the Sea. Such efforts have also catalyzed the commitment of member countries in implementation of related Chapters of Agenda 21 of UNCED in order to achieve sustainable development.

G. Coordination and liaison with other United Nations agencies

38. The coordination and liaison activities with other United Nations agencies, international regional and intergovernmental organizations as well as multilateral development banks in the field of mineral resources development have been actively pursued. In this regard, the ESCAP secretariat will strive to further strengthen and promote joint mineral sector development, environmental and urban geology activities as well as those related to marine affairs with UNDP, ADB, CCOP, SOPAC, IOMAC, UNDDSMS, UNCTAD, UN/OLA-DOALS though joint execution of national UNDP projects, joint regional programming exercises, attendance at annual meetings and training sessions, presentation of keynote papers at interregional seminars, assistance in formulation of work plans, programmes and regional projects as well as regular consultations on the development of mineral resources in selected ESCAP countries.

III. NEW AND FUTURE USES TO WHICH REMOTE SENSING TECHNOLOGY AND DATA SETS CAN BE APPLIED IN THE MINERAL AND WATER RESOURCES IN THE ESCAP REGION

A. Current activities of ESCAP in the field of space technology applications (Remote Sensing/GIS) to natural resources (water/minerals) management

(a) Applications of remote sensing/GIS to natural resources (water/minerals) management

39. Coastal zone monitoring, marine ecosystem management, landuse and landcover change detection, river course monitoring, surface and groundwater resources identification, tropical cyclone studies and monsoon monitoring research were a few areas of space technology applications including remote sensing and GIS in the field of water and mineral resources for which project profiles were prepared by an Expert Group Meeting on Space Technology Applications for Sustainable Development in Asia and the Pacific that was held in Bangkok from 30 January to 3 February 1995. This was a follow-up effort for the implementation of the recommendations of the Ministerial Conference on Space Applications for Development held in Beijing in September 1994. The Ministerial Conference, through the Beijing Declaration on Space Technology Applications for Environmentally Sound and Sustainable Development launched the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific (RESAP). The project profiles thus developed will be considered for implementation by ESCAP under RESAP.

40. The portfolio of project profiles thus prepared was circulated to the participating member countries at the annual session of the Intergovernmental Consultative Committee (ICC) on the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific (RESAP) that was held in Dhaka, Bangladesh from 10 to 16 June 1995. In the Dhaka Meeting, a number of countries indicated their interests in participating in some of the activities proposed in the project profiles. A number of donor countries also expressed their interests in assisting in the implementation of these projects. A tentative workplan that was examined and approved at the Dhaka session of ICC included activities related to landuse planning (soil and minerals), tropical ecosystem management (natural resources management), integrated applications of remote sensing and GIS in land and water (water resource), marine and coastal resources (water, minerals and natural resources) etc.

41. In landuse planning, ESCAP organized a training course on the integrated use of GIS and remote sensing. The training was conducted by the Faculty of Geography of the Gadjah Mada University, Yogyakarta, Indonesia from 22 August to 21 October 1994. Fifteen participants from 10 member countries attended the training course. The training included basic courses in the integration of remote sensing with GIS for landuse planning as well as practical exercises and case studies using RS/GIS software available in the countries of the participants so that they would be able to start using their own equipment upon their return. The trainees, upon their return, have contributed to strengthening the organizations they belong to in their use of remote sensing/GIS for landuse planning activities. This was a TCDC training course for which the Government of Indonesia provided the fellowships and all other training expenses from its TCDC fund and matching travel expenses for trainees from the above-mentioned developing ESCAP member countries were arranged from the ESCAP/UNDP GIS/RSRP project.

42. In the Pacific, a water and land-related activity was organized at Suva, Fiji from 13 to 17 February 1995. This was a Workshop on Remote Sensing/GIS for a Land and Marine Resources and Environment Management in the Pacific. It was jointly organized by the Fiji Ministry of Lands, Mineral Resources and Energy and ESCAP and was attended by 72 participants and observers from 29 countries and organizations. The Workshop had two main objectives: the first one was to expose senior officials from South Pacific Island countries from departments utilizing remote sensing and/or GIS for land and marine resources and environment management to the new technology developments through exchange of information on the status of development and a series of lectures on the latest GIS and remote sensing applications. The second objective was to formulate a subregional action plan in remote sensing and GIS applications for development as a follow-up to the Ministerial Conference on Space Applications for Development in Asia and the Pacific held in September 1994.

43. Tropical ecosystem management covers the fields of water resources management in the tropics, as well as mineral and other natural resources management activities. Remote sensing and GIS is now being widely used in ecosystem management. The ESCAP secretariat has undertaken two activities on remote sensing and GIS applications in this field. Both these activities were funded by the National Space Development Agency (NASDA) of Japan. The activities were organized with technical support from the Remote Sensing Technology Centre (RESTEC) of Japan. The 1994 activity was held

in Bali, Indonesia from 23 to 28 August 1994 with the Indonesian Space Agency LAPAN providing host facilities. A similar seminar-cum-training activity was organized from 4 to 9 September 1995 at Subic, Philippines with the Government of the Philippines, through its National Committee on Remote Sensing, providing host facilities.

44. Both these activities targeted two groups of people involved in ecosystem management (policy level and technical level). Policy-level professionals were exposed to the integrated use of GIS and RS for the sustainable development of tropical ecosystems through the various lectures and presentations. The technical-level experts were provided hands-on training on applications of GIS/RS to ecosystem management. The proceedings of the seminar including all technical presentations and discussions as well s a report on the training and training material, will serve as a reference manual for continuing efforts in remote sensing and GIS applications for tropical ecosystem management in the ESCAP region. The seminar at Bali was attended by 65 participants from 21 countries and organizations and the training component was attended by 18 junior-level participants from 11 countries. The seminar at Subic was attended by 61 participants from 19 countries and organizations and the training activity by 15 participants from 12 countries.

(b) Coordination and liaison with other United Nations agencies

45. Among the many mandates of the Regional Space Applications Programme for Development, harmonization of the activities of the United Nations and those of non-governmental organizations in this new field of space technology applications for sustainable development is an important one. Towards the fulfilment of this mandate, ESCAP continued its association with the Asian Association of Remote Sensing (AARS), which is the largest and oldest non-governmental association of remote sensing scientists and specialists in Asia. The 1994 Asian Conference on Remote Sensing (ACRS), which was the fifteenth in the series, was held in Bangalore, India from 17 to 23 November. ACRS was jointly organized by AARS and the Department of Space, Government of India. ACRS is a unique example of government/non-government cooperation for technology transfer and information exchange. As part of ESCAP's commitment to such cooperative efforts for regional development in this new field of technology, a Regional Seminar on Integrated Applications of Remote Sensing and GIS for Land and Water Resources Management was organized as a parallel activity to ACRS at Bangalore from 16 to 19 November 1994. The seminar was participated in by 75 remote sensing and GIS specialists who enjoyed the opportunity to interact with over 300 international scientists and specialists who attended the 15th Asian Conference on Remote Sensing. The participants in the seminar were also able to attend a number of technical sessions and view the posters associated with the 15th Asian Conference on Remote Sensing. Themes of the technical and poster sessions of ACRS covered applications of remote sensing and GIS in water, mineral and natural resources.

46. ESCAP organized the first meeting of the reconstituted Intergovernmental Consultative Committee at Dhaka in June 1995. The 1995 session of ICC approved the terms of reference of ICC on RESAP which will operate under the purview of the Committee on Environment and Sustainable Development to advise as appropriate, on the implementation of RESAP. The 1995 ICC session was attended by a number of UN

agencies including UNDP, UNEP, UNESCO, UNCRD and other intergovernmental organizations including MRCS (the Mekong River Commission Secretariat).

47. The Regional Strategy identifies the need of an inter-agency forum to ensure cooperation and coordination among the UN system and donor agencies in the implementation of the recommendations of the Ministerial Conference. In pursuance of the recommendation, the ESCAP secretariat took an initiative to establish an Inter-agency Subcommittee on Space Applications for Sustainable Development in Asia and the Pacific and the first session of the Subcommittee was organized from 30 to 31 October 1995 at Bangkok. Representatives from APT, ESA, ESCAP, FAO, ITU, UNEP, UNDP, WMO, and observers from Australia, China, France, Japan, Republic of Korea, Netherlands and USA also attended the meeting. The meeting reviewed activities in relation with the implementation of the Ministerial Conference's recommendations, finalized a Terms of Reference for the Sub-committee and also discussed regional cooperation projects as well as explored ways and means for regional cooperation and collaboration in space applications for development in Asia and the Pacific.

48. In addition, staff from the ESCAP secretariat also participated in meetings organized by other agencies such as the Expert Group Meeting of the Establishment of a Permanent Committee on Geographic Information Infrastructure organized by United Nations Department of Development Support and Management Services held in Kuala Lumpur, Malaysia last July. The ESCAP secretariat was also invited as a high-level steering committee member to attend the Commencement Workshop on the Greater Mekong Subregion Cooperative Environment and Information System Programme, organized by ADB of Manila on 3-4 October 1995 in cooperation with UNEP and the Mekong River Commission.

B. New and emerging uses of remote sensing/GIS in natural resources management

Introduction

49. Remote sensing and geographic information system as well as other related spatial information technology such as satellite-based positioning systems have together become an essential tool for sustainable development planning. These new and emerging technology applications have, as a matter of fact, become an integral part of sustainable natural resources development and management programme in Asia and the Pacific.

50. After more than two decades of satellite remote sensing development, remote sensing technology has now become operational and indispensable for providing information regarding natural resources and environment for decision making. Large, complex and often bewildering remote sensing data sets are now available, offering spatial resolutions varying from 10m to 1,000 meters in various spectral bands. These data sets can be obtained by natural resource managers and planners at costs ranging from a few dollars per sq km in digital form of raw data to a few hundred dollars per sq km in the form of value-added information.

51. In recent years, the commercialization of remote sensing and involvement of private industries have further accelerated remote sensing development that have been initiated and mostly supported as governmental programmes. In the ESCAP region alone, there are 30 national remote sensing programmes/centres, 11 earth observation satellite ground receiving stations and 3 comprehensive national remote sensing satellite programmes, as well as mushroom development of the spatial information industry. It is encouraging to note that, in the next decades, there will be at least 25 land data satellites to be launched by governments or private industries, most of which are new generation satellite technologies.

(a) Major technological developments

52. Advanced space technology will in the near future contribute significantly to the new and emerging use of remote sensing and GIS technologies for natural resources management and environment monitoring. Three major technological developments are envisaged, namely: (1) high spatial resolution, (2) hyperspectral imaging and (3) imaging radar technology. Most of earth observation satellites planned for the next decade will provide data with a spatial resolution of 1-3 meters, an improvement of one order of magnitude as compared to that are available in current satellite systems. A new generation of remote sensors will overcome one of the most significant limitations of remote sensing technology — the ability to separate colours mostly wanted in the mining industry, by providing hyperspectral imaging data. In addition to 1-3 meters spatial resolution, the users may have a choice of data from few spectral bands up to 250 bands, according to the state-of-the-art technologies. Hence, geologists are extremely interested in space and airborne hyperspectral imaging sensors that have the ability to sense wavelengths beyond the long end of the visible spectrum and to make distinctions between different colours in order to identify subtle changes in rock composition. Radar technology, thanks to its cloud-penetration, whole-weather capability, has become a significant tool for acquiring information over tropical regions. Radar application potentiality in geological studies and watershed management has already been demonstrated from experimental uses of data from JERS-1, ERS-1, Seasat, Sir-A/B and the simulation of Radarsat that was recently launched.

53. Geographic information systems technology, developed independently but in parallel with remote sensing, is an enabling technology that has become another important tool for development planning. Benefitting from rapid development of computer technology and computer software engineering, the integration of re:note sensing and GIS has become a reality, that will soon lead to the true operationalization of spatial information infrastructure for natural resources management and environmental monitoring in the next decade.

54. Within the next decade, as the new and emerging uses of remote sensing and GIS technologies continues to develop, information about natural resources will be increasingly integrated and access to it will continue to spread eventually reaching all levels of natural resources organizations. Organizations dealing with transboundary issues such as watershed management and forest management will be able to access global databases containing multiple data sets required for analysis and decision making. Databases built

up and commonly used by individual sectors will continue to grow larger and will be readily accessible through networks of varying spatial extents. Practical and useful applications of expert systems in connection with models built up as decision support tools to assist in the decision making and planning process, integrated with remote sensing and GIS databases, will become operational for natural resources management.

(b) Geological mapping and mineral resource assessment

55. In the field of geological mapping, remote sensing data will be used with other data layers provided through GIS databases for deriving various information. High spatial and spectral resolution data permits detailed lithologic and stratigraphic discrimination based on subtle changes in mineralogy. Thermal infrared data provide information notably for silicate and carbonate minerals and expand the capability for delineating lithologic units. Radar imagery shows variations in fold geometry that are controlled by faults in the basement rocks. Imaging spectrometers allow for detailed lithologic identification based on mineral content. For example, the distribution of the individual iron oxide and hydroxide minerals is useful for geological mapping in general and for hydrothermal alteration zonation mapping in particular. Computer image processing technology will be further developed as a major tool in geological mapping.

56. Mapping mineral resources, fossil fuels and geothermal resources is considered one of the major tasks in mineral resources management and development planning. Remote sensing data have been used in the mapping of anomalous limonite concentrations for finding hydrothermally altered rocks, identifying clays and other OH-bearing minerals, and interpreting linear structures to help characterize structure setting. Multispectral and thermal remote sensing data as well as radar images have been used together to interpret geological structure important in the accumulation of petroleum deposits, sedimentary facies affecting petroleum accumulation and possible carbonate accumulations. Future capabilities of remote sensing in mineral resources studies will involve multi-source data analysis and processing through GIS with built-in expert system in the context of mineralizing systems.

(c) Water resources assessment and management

57. In the field of water resources management and development, the unique role of geographic information systems and remote sensing technology has been increasingly recognized as evidenced by the wide use made of them. GIS, for example, allows water resources managers and specialists to store, manipulate and process hundreds of megabytes of point source data collected for watershed management and development planning. Data sources of various scales and spatial contents such as topography, soil, landuse, water resources, water quality and associated non-spatial social and economic data, can be acquired into a GIS for overlaying, modelling, manipulating and analysing to come up with various scenarios of resource utilization, preservation and development. This process involves both the time and spatial domains and would normally be difficult or even impossible to perform using traditional methodologies.

58. As spatial resolution improves to 1-3 meters and imaging radar systems become operational in the next decade, water resource assessment and management will be much improved by using the new generation satellite data. Visible and near infrared techniques will continue to be used to provide direct observation of water bodies at high spatial resolutions, including the extent of snow and ice, ice concentration and turbidity. Data beyond the visible band will be used to interpret surface features associated with surface water such as surficial geologic and geomorphologic features, vegetation and indicators of evapotranspiration. Hyperspectral thermal-infrared scanning can be used to examine ground-water discharge and diffuse shoreline seepage. Imaging radar technology will be used for real-time monitoring and other water-related disasters, particularly under the condition of heavy rains or continuous cloud covers.

59. Remote sensing and GIS technology will continue to develop rapidly and the new and emerging use of the technology to be limited only by human imagination. In order to benefit from such technology applications for sustainable development and management of natural resources, it has become of paramount importance that adequate national capacity be built up in developing nations, through technical assistance and international cooperation, as well as developing indigenous capability through enhanced education and training programmes. The United Nations, through its various organs such as ESCAP, has been assisting its members and associate members in the past two decades or more in developing remote sensing and GIS capability and will continue to provide a catalytic role in national and regional capacity building in the use of new and emerging remote sensing and GIS technologies for sustainable natural resources and environment management.

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REVIEW OF PROGRESS ON WATER-RELATED ISSUES: REGIONAL AND GLOBAL INFORMATION ON THE STATE OF THE WORLD'S FRESHWATER RESOURCES

Freshwater resources in Asia and the Pacific

Note by the Secretary-General

The report of the Economic and Social Commission for Asia and the Pacific on progress made and issues arising in the implementation of the Mar del Plata Action Plan and the water-related recommendations of Agenda 21, available in the language of submission, is contained in the annex below.

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Annex

REPORT OF THE ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC ON FRESHWATER RESOURCES

INTRODUCTION

1. The present report is submitted to the Third Session of the Committee on Natural Resources in accordance with Economic and Social Council resolution 1994/308, which stipulated that reports by the regional commissions on progress made and issues arising in the implementations of the Mar del Plata Action Plan and the water-related recommendations of Agenda 21, including case studies available from Governments in their respective regions, would be submitted under agenda item 4(a) of the provisional agenda of the Third Session of the Committee.

2. To the extent that information is available, the report endeavours to provide an overview of developments and trends in Asia and the Pacific in response to the Mar del Plata Action Plan and to the relevant recommendations of UNCED as contained in Chapter 18 of Agenda 21. The report is mostly based on information collected by the secretariat and the data provided by some countries in their country reports in connection with various recent activities organized by ESCAP. Some additional information was obtained from other organizations of the United Nations system.

I. GENERAL OVERVIEW

A. Water resources

3. The Asian and Pacific region, as defined at the beginning of 1995, extended over a total area of about 35 million km^2 or 26 per cent of the world's land area. With nearly 60 per cent of the world's population and over 60 per cent of the world's irrigated land, the region is more densely populated and more intensively cultivated than any other region. The region also displays various types of physical features, from arid deserts to the most humid areas of the world.

4. There is an extremely uneven distribution of precipitation over different parts of the region. For example, precipitation is exceptionally abundant on the southern slopes of the Himalayas, on the western slopes of the mountains of India and Indo-China, and on the islands of Indonesia, which receive annually from 1,500 mm to excess of 3,000 mm of rain and in some locations considerably more. On the other hand, almost all the north-western part of the region is extremely dry, with an annual precipitation of less than 200 mm.

5. Moreover, not only is there a sharp difference in the amount of total annual precipitation, but precipitation also varies considerably from one season to another during the year. The rainfall in a large part of the region is characterized by a monsoon climate pattern with very distinctive dry and rainy seasons. During the long dry season, temporary water shortage is experienced in many river basins, while during the rainy season severe floods may cause tremendous damage in the same river basins.

6. The Asian and Pacific region has several of the world's most important river systems. Seven of Asia's largest river systems, namely the Chang Jiang, Huang He, Mekong, Ayeyarwaddy, Brahmaputra, Ganges and Indus, have a total drainage area of more than 6 million km^2, much of which is heavily populated, particularly along their lower reaches. Therefore, the economic development and the welfare of people in this region are very dependent on the progress made in the development and management of its water resources.

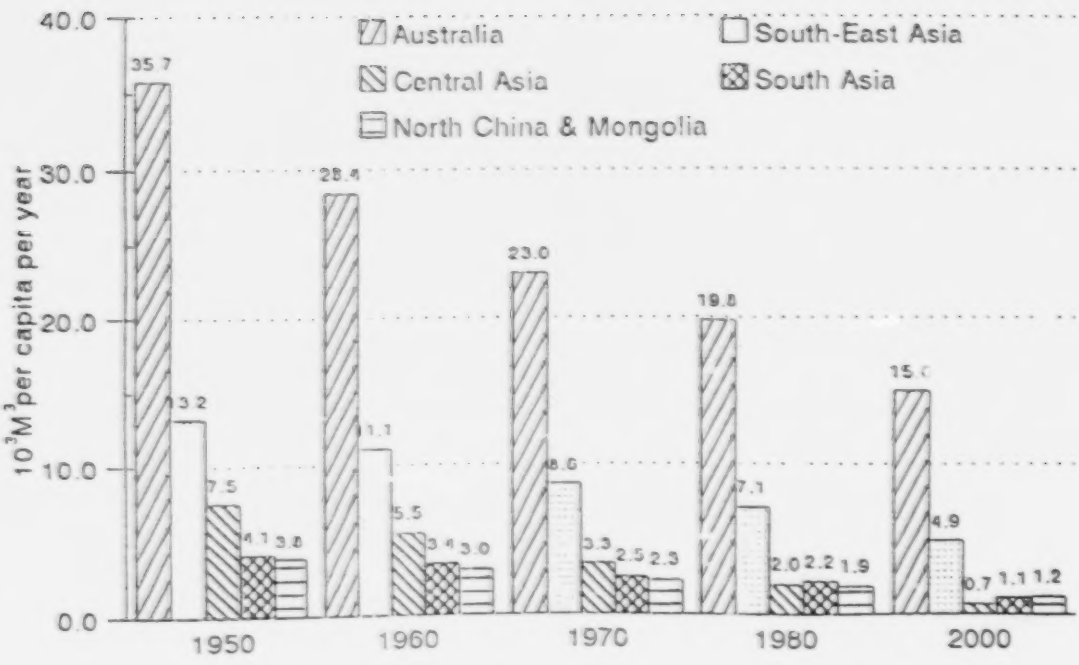
7. The most meaningful measure of freshwater resources is the total annual flow of rivers and the recharge to aquifers, that is the annual average amount of renewable water resources. The total volume of run-off on earth is estimated to be between 41,000 km^3 and 46,000 km^3. The share of the ESCAP region in the global run-off is about 12,500 km^3, comprising between 27 and 30 per cent of the total.

8. In the ESCAP region, with the population estimated at 3,323 million, as of the middle of 1995, an overall average per capita availability of water is estimated at about 3,760 m^3 per year. This amount is less than the relevant estimates for the other regions with the exception of West Asia. Naturally, the per capita availability has been decreasing with the growth of population, which is estimated at 1.6 per cent for the region as a whole, with the highest rates of 2.1 per cent in South Asia and 1.8 per cent in South-East Asia. The estimates for changes in water availability per capita by subregion over the period from 1950 to 2000 are presented in Figure 1, offering a general idea of the order of magnitude of and trends in the availability of renewable water resources in the region.

9. Due to rapidly increasing population, by the year 2000, the per capita water availability would be considerably less compared to that in 1950, almost one fourth in South Asia, one third in north China and Mongolia and forty per cent in south-east China. The most critical ten-fold decrease from 7,500 m^3 in 1950 would be occurring in Central Asia, which now experiences a severe water crisis in the Aral Sea Basin.

10. It should also be noted that users can obtain only a part of the renewable water resources from water bodies, owing to the high variability of streamflow between low water and flood seasons, inaccessibility of some water courses, and the lack of storage sites on many catchments. Since a large part of the run-off, occurring in the form of flood flows of relatively short duration, flows out to sea unarrested, the volume of usable flow is substantially less than the total run-off and the renewable water resource. Moreover, a significant part of water resources is available in remote areas of the region where it is impractical and uneconomic to undertake development activities.

Figure 1: Estimates of water availability in Asia and the Pacific



Source: After Shiklomanov, I.A. The world's water resources. International Symposium to Commemorate the 25 years of IHD/IHP, UNESCO, Paris, 1991

B. Water utilization

11. Although the countries of the Asian and Pacific region have experienced varying rates and patterns of economic development, the region, as a whole, has been the most dynamically developing part of the world with stable overall annual growth rates. This remarkably rapid expansion of many Asian economies accompanied by the population growth has not only raised the standards of living of the people in the region but has also put steadily growing pressure on water resources in many countries in Asia and the Pacific.

12. Water use is increasing rapidly in almost all countries of the region. Rising demand for water from the domestic, industrial and agriculture sectors coupled with the decreased availability of water resources caused by their depletion and degradation has created problems of sustainability of water resources development in many parts of the Asian and Pacific region.

13. The total amount of annual water withdrawal in the ESCAP region is roughly estimated at around 1,500 km^3, or 450 m^3 per capita per year, accounting for about 12 per cent of the regional renewable water resources. It is recognized that availability of water tends to become a limiting factor in national socio-economic development when water withdrawal exceeds 20 per cent of annual total renewable water resources. In several countries, such as Pakistan, Uzbekistan and Turkmenistan, more than half of the total renewable water resources, including transboundary inflows from neighbouring countries, are already withdrawn annually to meet the demands of the national economy. These countries have been experiencing serious difficulties in expanding their sectors of economy that use much of the water, that is irrigated agriculture. In a large number of other countries, the annual amount of water abstraction exceeds 20 per cent of their respective renewable water resources, implying that the scarcity of water may start becoming a limiting factor in national socio-economic development in those countries, as well.

14. In spite of an economic growth throughout the region and sharp rise in urban population, water use in Asia and the Pacific is still dominated by agriculture. About 80-85 per cent of the volume of water abstracted annually in the region is accounted for by mainly irrigated agriculture. Water withdrawal for domestic and industrial uses is currently relatively small in almost all countries of the region with a few exceptions, however, it is rising steadily thus resulting often in conflicts over water allocation with agricultural water uses.

C. State of the aquatic environment

15. In many parts of the ESCAP region, the aquatic environment has been progressively deteriorating mostly owing to over-exploitation of water resources and

their contamination caused by discharges of domestic, municipal, agricultural and industrial effluents without undergoing proper treatment.

16. Since water demand has already surpassed the sustainable yield of existing freshwater sources in many parts of the region, water is often abstracted from such sources at volumes far exceeding their replenishment rates. This is especially relevant to groundwater resources, because the reliance on groundwater has been increasing with the reduction in the potential for developing additional surface water supplies. The remediation of negative impacts of groundwater overpumping such as the lowering of the water table, land subsidence, seawater intrusion into aquifers in coastal zones, deterioration of water quality, etc. usually takes an extended period of time.

17. The heavy pollution load caused by disposal of municipal, agricultural and industrial wastes has exceeded the capacity of a large number of water bodies to accommodate such wastes, and subsequently many rivers have lost their potential as water supply sources for downstream users.

18. In general, the quality of freshwater varies greatly throughout the region. The severity and extent of water quality problems in the ESCAP region is presented in Table 1.

II. REVIEW OF THE PROGRESS

19. The countries of Asia and the Pacific have made great strides in improving the management of their water resources since the adoption of the Mar del Plata Action Plan by the United Nations Water Conference in 1977. The progress achieved in the implementation of the provisions of the Action Plan in the region has been regularly surveyed by the ESCAP secretariat and then analyzed, summarized and reported to the relevant legislative bodies of ESCAP and to the Committee on Natural Resources of ECOSOC.

20. In this section of the report, an additional first attempt has been made to survey also the progress achieved in the implementation of the water-related recommendations of Agenda 21 on freshwater resources, contained in Chapter 18. As only a short period of time has elapsed since UNCED, the implementation levels of the imperatives of Agenda 21 have not yet been comprehensively realized, hence systematized country information on the implementation of Agenda 21 is rather scarce.

A. Integrated water resources development and management

21. The concept of integrated water resources management that implies, as articulated in Agenda 21, a dynamic, interactive, iterative and multisectoral

Table 1. Water quality issues in the ESCAP region

Quality Issues	Indian Subcontinent	South-East Asia	Pacific Islands	China	Japan, Australia and New Zealand
Pathogenic agents	1-3	1-2	2-3	1-3	0-1
Organic matter	1-3	0-2	0-1	1-3	0-1
Salinization	0-1	0-1	0-3	0-2	0-1
Nitrate	0-1	0-1	1-2	0-2	0-1
Fluoride	0-1	0	0	0-2	0
Eutrophication	0-1	0-3	0	0-2	0-1
Heavy metals	0-1	0-2	0-1	0-2	0-2
Pesticides	0-1	0-1	0-1	0-1	0-1
Sediment load	0-2	0-2	0-1	0-3	0-1
Acidification	0	0-1	0	0-1	0-1

Source: Water Quality, Progress in Implementing the Mar del Plata Action Plan and Strategy for the 1990s. 1991. UN Publication.

0 = No pollution or irrelevant
1 = Some pollution, water can be used if appropriate measures are taken
2 = Major pollution
3 = Severe pollution affecting basic water uses.

approach to water resources management and the integration of sectoral water plans and programmes within the framework of national economic and social policy, is gaining recognition within the region. For example, the goal of sustainable development is implicit in the current Eighth Five Year Plan of India (1992-1997), which underlines the significance of ensuring a coordinated and integrated governmental action for conserving nature and ensuring sustainable use of natural resources through a participatory process. In China's Agenda 21, it is recognized that the realization of objectives of other fields of governmental planning becomes increasingly dependent on successful water resources management.

22. In line with the recommendations of the Mar del Plata Action Plan and Agenda 21, most of the countries of the region have adopted or revised their national water policies, reflecting the priority attached to water resources development within the national socio-economic development plans. Thus, in India, the National Water Policy adopted in 1987 aims at planning, developing and conserving the water resources on an integrated and environmentally sound basis, keeping in view the needs of the states concerned. Indonesia undertook a major policy review of its water resources policy during the period of 1991-1994 to meet the needs of development and to accommodate the changing environmental and resource requirements and society's aspirations. The policy review took into consideration the Agenda 21 approach to

deal holistically with water resources management issues and the four main principles of the Dublin Statement. In Pakistan, a comprehensive national water policy is expected to be formulated to provide an appropriate framework for water resources management by 1998.

23. In a number of the countries of the region, national water resources policies have been translated into action programmes or master water plans. The scope of these activities ranges from more sector-oriented plans, such as improvement of water quality, to more comprehensive development plans. Following are some examples from countries in the Asian-Pacific region:

- In Bhutan, a Power System Master Plan (1994) has been formulated to identify a number of possible sites for hydropower plants. These sites have been selected employing technical, economic and environmental criteria.

- In Bangladesh, a National Water Plan II for the period 1990-2010 has been prepared as an updated continuation of the National Water Plan which covered the period between 1985 and 2005. In addition, a Flood Action Plan had been formulated following the catastrophic floods of 1987 and 1988.

- In India, although a comprehensive master plan has not yet been completed, master plans for specific purposes such as irrigation or flood control have been drawn up for a large part of the country. Most of the large states have prospective master plans for irrigation and some for hydropower. Altogether about half of India's land area is covered by master plan activities in one form or another.

- In the Islamic Republic of Iran, the Second Five-Year Socio-Economic and Cultural Development Plan (1995-1999) includes a number of objectives related to the environment and water resources. Also specific targets have been set for various water resources development projects.

- Maldives has developed an action plan in the field of environmental management which gives priority to the development of national policy guidelines concerning wise use of groundwater resources.

- In response to growing concerns over the degradation of the water resources of the country, Pakistan has formulated a water sector investment plan. The main objective of this plan is to identify priorities in the water sectors for investment. The plan also includes such issues as environmental management and public involvement to be dealt with.

24. In several other countries of the region, the preparatory work for the formulation or revision of national action plans has been initiated, often with the assistance from international organizations. In Mongolia, there is the intention to revise the Master Water Plan elaborated in the first half of the 1970s, in order to reflect adequately the new social and economic realities of the country's transition period to a market economy. In Sri Lanka, it is envisaged to formulate an action plan for comprehensive water resources management that will synthesize the results of the subsectoral plans at the national planning level. The action plan is expected to have a positive effect on the quality of investments in irrigation, water supply, power generation and environment protection subsectors, and to strengthen their linkage with national development goals.

25. The concept of management of water resources within a river basin or sub-basin context, facilitating integration of land- and water-related aspects, has been widely applied in the region. In Australia, China and Japan, water management has been already been exercised at the river basin level to a certain extent for a number of rivers of national significance. In India, the national water policy asserts that water resources planning be undertaken for a hydrological unit, such as a drainage basin or sub-basin. In Indonesia, basin institutions for water resources management, including for both planning and operation, have been introduced recently in some river basins, but have yet to become fully functional.

26. Basin-wide approach might be quite beneficial to the management of a large number of transboundary water systems in the region if the riparians could agree to cooperate for formulation and implementation of development plans. For example, Indicative Plan for the development of land, water and related resources of the Lower Mekong basin was prepared in 1970 by the then Committee for Coordination of Investigations of the Lower Mekong Basin, comprising Cambodia, Lao PDR, Thailand and Viet Nam. The Plan was revised in 1987, and at present a number of specific projects identified in the Plan are being implemented under the auspices of the Mekong River Commission, which was set up in April 1995 as a replacement to the above mentioned Committee.

27. In Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan reached in 1992 an agreement on joint management of transboundary waters in the the Aral Sea Basin, and established the river basin authorities for the Amu-Darya and the Syr-Darya. Rivers, which are the main tributaries of the Aral Sea . These authorities have been entrusted with the main function of allocation of the scarce water resources available to the riparian countries, also taking into account the need to release a specified amount of water into the Aral Sea.

28. There are several other transboundary rivers in the region, where the respective riparian countries undertake jointly development and management activities in the field of water and water-related resources.

29. The old problem of fragmentation of institutional responsibilities for water resources development, management and conservation among sectoral agencies, central and provincial authorities, which had been a major obstacle to the introduction of integrated water resources management, has been alleviated to acertain extent in several countries of the region by creating some institutional mechanisms for coordination. In China, India, Thailand and some other countries, there are interagency coordination committees and groups composed of high ranking representatives of various agencies and ministries dealing with water resources issues. However, the coordination of activities on water resources development, conservation and protection needs further improvement, particularly at lower administrative levels.

30. This is particularly important in the light of the on-going exercise on decentralization of responsibilities in the water sector, which is taking place in several countries of the region. For example in China, the regional rights in the development and management of water resources will be reinforced, and, when possible, city or province governments will be assigned with the appropriate authority to enable direct management of water resources. In India, multidisciplinary units in charge of preparing comprehensive master water plans have been established in some states. In New Zealand, regional authorities have been entrusted with the power and responsibility under the Resource Management Act of 1991, to carry out or oversee all aspects of water management in their respective regions. In Pakistan, the further decentralization of water resources management will be initiated in accordance with the provisions of the country's Eighth Five Year Plan (1993-1998) by transforming the provincial irrigation departments into provincial irrigation and drainage authorities.

31. Although most countries of the region have adopted water legislation regulating to a certain extent the ownership, use and protection of water resources, there is a need in some countries, especially in the countries with economies in transition, to review the existing water legislation in order to incorporate relevant provisions associated with the economic value of water, rational use of finite water resources, protection of the aquatic environment, etc. For example, in Lao PDR, a Water Law has been drafted recently and submitted for approval to the National Assembly. The proposed law aims to streamline policies on water resources assessment, planning, use, quality and protection, and designates a central administrator for water resources management. In Mongolia, the new Water Law that became effective from 5 June 1995, incorporates water management concepts such as water resources development in the context of sustainability, recognition of EIA procedures and some others. In Central Asian states, water legislation is also being revised substantially.

B. Water resources assessment

31. The importance of assessment of surface water and groundwater resources, including their both quantity and quality, has been clearly recognized in Asia and the Pacific as an essential prerequisite to the sustainable development and integrated management of water resources. The inadequacy of information on quantitative and qualitative aspects of water resources for planning and decision-making has resulted

in several cases in overestimation of the potential usable water sources. This situation subsequently led to mislocation of agricultural and industrial projects which are now unable to operate in full capacity due to the shortage of water supply.

32. Throughout Asia and the Pacific, there is an extremely uneven density of hydrometeorological observation networks, ranging from a dense network in Japan to only a few gauges scattered over the vast areas of Tibet and the Himalayas and to the solitary gauge on a Pacific atoll, that makes proper assessment of water resources a very hard task indeed. On the average, in the developing countries of the region the density of network varies from 2000 km^2 to 5000 km^2 per hydrometeorological station, while in Europe this indicator ranges from 140 km^2 to 400 km^2. This is a vastly different level of coverage.

33. In a large number of the countries in the ESCAP region, available information on water resources is still inadequate to satisfy the data requirements of their development activities. For example, Sri Lanka has indicated that the rapid rate of water resources utilization in the country highlights the need for a complete reappraisal of the available water resources and devising a strategy for their future development and conservation to be formulated in a national water master plan. Viet Nam views the lack of reliable hydrological and hydrometeorological information as one of the obstacles in achieving sustainable and environmentally sound development and management of its water resources. In India, a project is planned to be implemented, with World Bank assistance, for undertaking systematic collection and analysis of hydrological data. Mongolia has indicated the need for immediate action with respect to the development of an adequate information system for both its surface water and groundwater, particularly concerning water quantity and quality.

34. In its Agenda 21, China announced that it will undertake studies on water resources assessment techniques, in its efforts to improve the existing hydrological network and add new monitoring stations for groundwater surveying. China will set up at all levels a water consumption accounting system as part of the state's data system. Furthermore, China will publish "The National Report on Water Resources" annually and carry on studies of advanced technologies for water resources assessment.

35. The assessment of renewable groundwater reserves remains a priority task for small islands and in coastal zones, where freshwater aquifers are vulnerable to salt-water intrusion. Thus, in Maldives, where no national assessment of fresh groundwater resources has been undertaken, the lack of environmental and resource information has been identified as one of the main constraints for rational decision-making.

36. There is a serious need for strengthening of coordinating arrangements in the collection and processing of data on water resources and their use. Some countries have an existing body with comprehensive responsibility for water resources assessment, and some are contemplating the establishment of such a body. However, most countries have chosen to strengthen their existing bodies. For

example, in India, the Ministry of Water Resources has set guidelines to standardize procedures for collecting samples from the rivers. Considering the varying interests and responsibilities of the different agencies, it was decided that work at different locations along rivers could continue to be undertaken by the different agencies, but practices would be made uniform so that data from all agencies could be compiled and published together to provide a complete picture of the river systems.

37. In order to support efforts of the countries concerned in the assessment of their water resources potential for meeting the current and foreseeable water demand, ESCAP has prepared in cooperation with the respective national agencies the relevant studies for China, Japan, Myanmar and Thailand. In addition, a guidebook to water resources and water use in 45 countries in Asia and the Pacific will be released soon by ESCAP. The chapter on Malaysia from the guidebook is attached to this paper as Annex.

C. Protection of water resources, water quality and aquatic resources

38. Many countries in the ESCAP region are threatened by the deterioration of the aquatic environment caused by the disposal of inadequately treated, sometimes untreated at all, domestic sewage and industrial waste waters, polluted run-off from urban areas and cultivated land, and by loss and destruction of catchment areas, deforestation and large-scale reclamation of wetlands. The water quality problems obviously vary in different parts of the region owing to a large variety of climatic, hydrological and hydrogeological conditions throughout Asia and the Pacific and different levels of socio-economic development in the countries of the region.

39. Although almost all countries in the region are conscious of the degradation and depletion of their water resources, efforts to protect the quality of the aquatic environment have often lagged behind the pace of population growth and development. National legislation for protecting water resources, water quality and aquatic ecosystems has been available in many countries, but not adequate in some countries, such as Kiribati, Mongolia, Nepal, Niue, Papua New Guinea and Uzbekistan. Moreover, in some other countries, for example, Vanuatu and Tuvalu, such legislation does not yet exist. Institutional frameworks for the protection of the aquatic environment are not available in many countries, and there is no adequate coordination of activities among the agencies concerned with water resources protection in a large number of the countries.

40. In several countries of the region, large-scale and ambitious programmes and action plans have been initiated to rehabilitate degraded waterstreams and depleted aquifers. Thus, in India, the National River Action Plan has been conceived with a view to carrying out pollution abatement works in 14 grossly polluted stretches in nine of 17 major rivers in the country and 14 less polluted stretches in the remaining 8 rivers. Other activities initiated in India for the improvement of water quality include Ganga Action Plan and Scheme of Common Effluent Treatment Plants. In Central Asia, five co-basin countries have approved a long-term programme, supported by the

international community, with the objective to stabilize the environment and improve management of the transboundary water resources of the Aral Sea basin. In accordance with China's Agenda 21, the government will undertake action for the protection of water sources and the aquatic environment to reverse the deterioration and exhaustion of water resources.

41. It is widely accepted in the region that in order to protect the aquatic environment and to increase the availability of freshwater of good quality, the pollution load on water resources should be drastically reduced by proper wastewater treatment, reuse and recycling of domestic sewage and industrial wastewater, introduction of appropriate low-waste water-saving technologies, and strict water quality control on industrial and municipal effluent. However, the enforcement of legal and economic measures, such as permits and regulations relating to wastewater disposal or effluent fees, is not often sufficient throughout the region.

D. Drinking water supply and sanitation

42. Safe water supplies and environmental sanitation are vital for improving living standards and health, alleviating poverty and protecting the environment. Therefore, the water supply and sanitation sector is normally given a high priority in their development efforts by national governments throughout the region.

43. As a result of the large population shifts from rural to urban areas, the priority for the 1990s in the water sector in much of the region is to improve water supply and sanitation in the urban areas of Asia. This includes not only drinking water supply for urban residents, but also water supply for industry, municipal uses and disposal of wastes. The rapid growth of the urban population seems to be overwhelming the financial and technological capacities of many developing countries in Asia and the Pacific to provide water supply and sanitation services to urban residents, particularly to the poor.

44. One of the concomitant features found in many rapidly expanding cities in the Asian and Pacific region is the tremendous increase in the number of the urban poor, who live mostly in slums and squatter settlements. These areas often do not have the basic necessities of proper water supply and sanitation facilities, and the urban poor suffer the most from the lack of a healthy environment within their homes and their neighbourhoods. Infant and child mortality rates may be considerably higher than the city average and there is a comparable difference in all other aspects of health and social well-being.

45. The lack of an adequate water supply also affects the economic welfare of the poor since people often have to pay for water provided by vendors at prices which may be substantially more than what is paid by customers served by a piped water system in a nearby area.

E. Water and sustainable urban development

46. Industrialization coupled with the growth of urban centres has been a major driving force behind national economic development in the developing countries of Asia and the Pacific. However, industrialization and urbanization have placed an incredible strain on water resources, since industrial, domestic and municipal users in urban areas are demanding a progressively greater share of water resources and are, at the same time, degrading these resources with their wastes. This strain has become critical in the larger urban centres of many developing countries of the region, which experience severe problems with both the availability and the quality of water needed to sustain urban populations and national development.

47. Until quite recently, water supply and waste disposal were not regarded as serious constraints to urban development. Since many major cities in the region, such as Bangkok, Dhaka, New Delhi and Shanghai, are located on the banks of large rivers, a cheap water supply was secured and the river's self-cleansing capacities were sufficient to remedy the polluting effects of wastewater discharges. However, with the fast growth of urban centres over the last decades, overuse of water resources, stemming from the efforts to satisfy the relentlessly increasing demand for water by urban users without due consideration to sustainability and protection of water resources, has contributed to water resources depletion and degradation in a number of river basins in Asia. In turn, the water resources degradation has resulted in reduced urban productivity, increased cost of manufacturing, lowered quality of life and, eventually, in the undermining of sustained economic growth and social development at these areas.

48. To meet urgent needs in the urban water sector and to manage water resources in the urban context more efficiently and in an environmentally sound and sustainable manner, countries are starting to reconsider and modify accordingly their current approaches to the formulation and implementation of water resources policies and action programmes.

49. It is becoming increasingly apparent that many of the problems facing urban areas in the water management sector are often basin-wide as the principal source of surface water supply may be located far upstream in the same river basin. Moreover, given the depletion of water resources in river basins with large urban areas, interbasin water transfer schemes are becoming common. There
are several such schemes, already in existence or planned in China, India, the Philippines, Thailand and some other countries of the region. In the cases of Hong Kong and Singapore, international arrangements have been made and expensive engineering works have been constructed to supply water from the territory of another country, namely, China and Malaysia, respectively.

F. Water for sustainable food production and rural development

50. In Asia and the Pacific, the sustainability of food production is increasingly dependent on sound and efficient use of water for irrigated agriculture. Approximately one third of the cultivated land in the region is under irrigation. As of 1992, the total irrigated area in Asia and the Pacific was about 150 million ha accounting for nearly 60 per cent of the world's total. Irrigated area in the region has been expanding steadily with an average annual growth rate of 1.1 per cent. It is expected that this rate will continue until the year 2000, whereas the annual population growth rate in the ESCAP region is estimated at 1.6 per cent. Therefore, to meet the growing demand for food, the production efficiency of the existing irrigation lands should be increased mainly through more rational use of land and water resources.

51. In all countries of the region except Singapore, the bulk of water is withdrawn for agriculture, mostly for irrigation. The share of water abstracted for agriculture varies from about 95 per cent of the total water withdrawal in the still predominantly agricultural economies of Bangladesh, Cambodia, Nepal Pakistan and Sri Lanka to around 64 per cent in the industrialized economies of Japan and the Republic of Korea. In China and India, around 84 per cent of total water abstraction is for agriculture.

52. However, the efficiency of irrigation water use is low throughout the region. It is estimated that in most irrigation schemes only about 40 per cent of the water taken into major canals reaches the fields and, owing to incorrect water application practices in the fields, the losses are further increased, in many places leading to waterlogging and salinization of valuable cropland.

53. Therefore, countries of the region are increasingly putting emphasis on improving the efficiency of irrigation water use through modernization of technologies and improvement of existing methods employed in irrigation schemes and rehabilitation of waterlogged and salinized irrigation lands. Expected water savings resulting from a reduction in demand by agriculture could be reallocated to non-agricultural uses which persistently require a larger share of water.

54. For example, in India, the National Water Board of the Ministry of Water Resources has recently finalized the draft of an irrigation management policy for consideration and recommendation by the National Water Resources Council. The policy aims at improving water application efficiency through the use of modern technologies such as drip/sprinkler irrigation and better on-farm irrigation methods. For ensuring improved irrigation efficiency, the need for maintaining irrigation systems at the optimum level has been emphasized, through provision of adequate finances and through changes in the financial arrangements including the linking of finances with irrigation revenues.

55. China, in order to increase its annual food production, has plans to modernize existing irrigation systems, improve water conservation and reclaim waterlogged lands.

56. In Pakistan, where about 10 per cent of the best agricultural land is already affected by salinity, Phase I of the National Drainage Programme (1996-2002) will be launched from 1 January 1996 in order to more effectively combat the problems of waterlogging and salinization on a basin-wide scale. The programme accords priority for improvement of existing drainage systems and better operation and maintenance in the future.

G. Impacts of climate change on water resources

57. It is anticipated that among the most adverse potential impacts of climate change may be its possible effects on the hydrological cycle and freshwater resources and through these on socio-economic activities. The economies of many countries in Asia could be very vulnerable to climate change, because a large percentage of their gross national product still comes from climate-sensitive and water-dependent agriculture.

58. Higher temperatures and reduced precipitation may lead to decreased water supplies and increased water demands, thus putting additional strains on the already fragile balance between water supply and demand in a number of countries. Even in areas where climate change may induce higher precipitation, the rainfall increase may also cause more severe flooding and associated harmful consequences.

59. In its Agenda 21, China announces that it has plans to complete a water survey system which employs new techniques to appraise the effects of climatic changes on flood occurrence and concentration, the economy and environment. Furthermore, China has also plans to formulate appropriate strategies for the forecast and control of the influence of climatic changes on water resources, and adopt effective measures to reduce the negative effects. At the same time, China aims to study the potential influence that the climatic changes may have over regions with high drought and flood occurrences.

60. Any appreciable rise in sea level would pose a definite threat of inundation in low-lying coastal areas in Bangladesh, China, Pakistan, Thailand, Viet Nam and some other countries with flat coastal lands. Small islands are particularly vulnerable to the anticipated sea level rise. For example, in Maldives, 80 per cent of the land area has an elevation of less than one metre above sea level. Hence the government is understandably very concerned about the potential impacts of the climate change on the sea level rise.

III. CAPACITY BUILDING AND MOBILIZATION OF RESOURCES

61. In Asia and the Pacific, the most critical issues for the implementation of Agenda 21 in part related to all the programme areas of Chapter 18 are (i) the inadequacy of existing institutions, in terms of their responsibilities, budgeting, staff training and coordination arrangements, to the requirements stemmed from the relevant provisions of Chapter 18, and (ii) the shortage of human and financial resources needed for achieving the goals of Agenda 21 in the freshwater sector.

62. Although, in a large number of countries of the region some institutional and legal reforms are in progress as presented in section II of the report, more drastic action might be needed soon to ensure integrated management and efficient protection of water resources considering the decreasing per capita availability of water and increasing competition of various users over scarce resource. The delegation of water management functions to lower levels in the process of decentralization leads to the necessity of involving millions of people in water management and protection activities. In response, some countries, such as China, India, Indonesia, Pakistan and Thailand, are undertaking vigorous capacity building programmes in the water sector.

63. In addition, the importance of increasing public awareness about water resources is gaining recognition in the region. Thus, in Japan, the public awareness of the high value of water resources has been promoted by governmental agencies. For example, the National Land Agency organizes various activities and initiates public campaigns aimed at enhancing the public's understanding of the limited availability of water resources and the importance of sustainable water resources development. One of the most prominent campaigns is the Water Week beginning on 1 August of each year which is proclaimed as the National Water Day. In India, Water Resources Day has been celebrated every year during April or May since 1986. Moreover, World Day for Water has been increasingly observed throughout the region on 22 March of each year since 1993. Awareness building activities carried out in connection with this Day are targeted at all groups of urban and rural population. The relevant information has been disseminated through leaflets, newspaper articles and radio and TV programmes.

64. The bulk of funds required for the implementation of the activities proposed in Chapter 18 is expected to come from the national Governments. However, it is obvious that the governmental funds allocated for water resources development, management and protection activities are not sufficient in many countries. Therefore, more attention needs be be given to the improvement of economic efficiency of water supply and irrigation projects, mobilization of resources of the private sector and involvement of communities.

65. For example, economic efficiency of water supply and irrigation projects can be improved by rehabilitating defective systems, reducing wastage and unaccounted for water, recycling and reusing wastewater and improving operation and maintenance. In several large cities in the region, such as Bangkok, Hanoi and Manila, urgent

measures have been undertaken to improve the efficiency of urban water services by mainly reducing the losses from the water supply systems.

66. An important resource, particularly in low-income settlements, is the contribution from local communities. By involving benefiting communities in the development of water supply, sanitation and water pollution prevention facilities and subsequent maintenance and operation of new facilities, the required investments can be reduced substantially. Some experience in motivating communities to take care of the development and management of local water supply and sanitation projects has been gained in China, India, Pakistan and several other countries of the region.

67. The involvement of private companies could reduce the financial burden borne by the governments in the freshwater sector. However, the transition from the government-run services to the private sector involvement might be a lengthy and complicated process, which needs to be planned and executed taking into account the prevailing socio-economic conditions in a particular country. Furthermore, in some countries, particularly in the countries with economies in transition, the local private sector is too weak to be interested in long-term commitments with relatively low rates of capital return. In such cases, foreign companies might be interested in investing in some water supply projects. Some French and British companies have been investing in water supply projects in China, Malaysia and Viet Nam.

Conclusions and recommendations

1. The comprehensive evaluation of the progress in the implementation of the Mar del Plata Action Plan and the water-related recommendations of Agenda 21 has been impeded by the scarcity and fragmentation of the information on relevant activities being undertaken by the countries of the Asian and Pacific region. In order to facilitate the monitoring of the implementation of Agenda 21 in the freshwater sector at the national, regional and global levels, a questionnaire might be prepared for collecting the relevant information from the Governments concerned. The proposed questionnaire can be made compatible with the 1983 questionnaire on the progress in the implementation of the Mar del Plata Action Plan in order to enable the Governments and the United Nations to review on a continuing and comparable basis the overall progress made in the implementation of both the Mar del Plata Action Plan and the water-related provisions of Agenda 21.

2. The awareness about the provisions and objectives of Agenda 21 in the freshwater sector is still inadequate among the governmental officials, the private sector and general public. Therefore, the further promotion of awareness about the water-related recommendations of Agenda 21, particularly at the subregional and national levels, is indispensable for the successful translation of those recommendations into appropriate action.

3. The programmes and activities of the countries concerned in capacity building in the freshwater sector in line with the pertinent recommendations of Agenda 21

need to be supported by the international community in a better concerted way. This is particularly relevant to the countries in transition to the market economy, many of which have only recently become exposed to the assistance from international and bilateral sources.

4. Review and revision of policies, action programmes and plans in the water sector should be carried out on a regular basis in the light of the requirements of Agenda 21 in order to reflect timely and adequately the recent socio-economic changes and current trends in the respective countries and to adjust them accordingly.

5. Urgent action towards the conservation of water resources, heavily polluted and depleted in a large number of areas throughout the region, should be taken in order to achieve sustainable water resources development. Within the framework of integrated water resources management, strong emphasis should be given to measures to increase the efficiency of water use, which is low in various sectors of the economy, particularly in irrigated agriculture, in many countries of the region, through demand management.

6. In order to reduce demand for water, a number of technical and regulatory measures could be introduced, including reduction of water losses, introduction and encouragement of use of water-saving appliances and water reuse. In addition, economic instruments such as charges, subsidies, taxes, fines and penalties should be applied more widely in the countries in Asia and the Pacific.

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Appendix

COUNTRY CASE STUDY

Water Resources and Water use in Malaysia

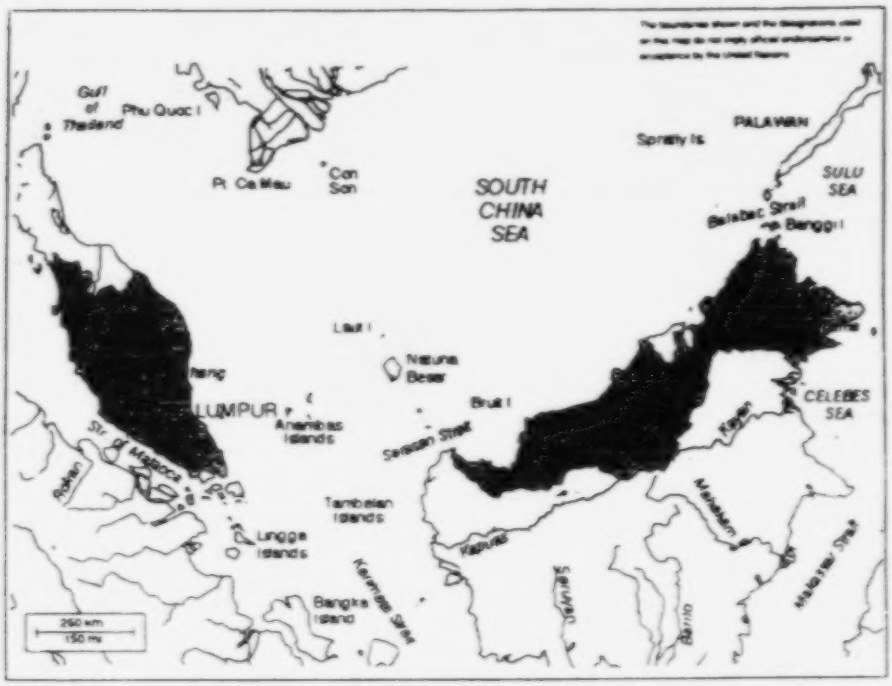

Figure 1. Regional drainage pattern and major surface water features of Malaysia

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This chapter on Malaysia was taken from the ESCAP publication "Guidebook to Water Resources, Use and Management in Asia and the Pacific", Volume One: Water Resources and Water Use, Water Resources Series No. 74, Sales No. E.96.II.F.15, New York, United Nations, 1996.

MALAYSIA

A. GENERAL

1. Physiography

Malaysia is a federation of 11 states in the Malay Peninsula and the states of Sarawak and Sabah on Borneo Island.

Highlands cover a large part of the Malay Peninsula, and more than half of the territory is more than 1,500 m high. Peninsular Malaysia is dominated by a mountainous core, which consists of a series of roughly parallel mountain ranges trending north-south. The most prominent is the Main Range, which extends for more than 400 km. Flat pieces of land are not extensive, and are restricted to between the mountainous core and the coast on either side of the peninsula. The coastal plain is more extensive along the western half of the peninsula, and averages about 50 km in width. Coastal plains on the eastern side are narrower and less continuous. The greatest width of the eastern plain is generally more swampy. The eastern plains are usually sandy, and in places are characterized by the presence of beach ridges. [1]

About 60 per cent of Sabah, on the Borneo Island, consists of mountainous terrains and highlands. Lowlands occur along the coast and major river valleys. The western part of Sabah is dominated by the north-east trending Crocker Range, which encompasses the Mount Kinbulu with an elevation of 4,094 metres. In the south-central part and in part of east Sabah the area is dominated by a series of circular to sub-circular basins ranging from 15 to 50 km across. The greater part of the east coast, including the Bangkoka, Sandakan and Dent peninsulas, consists of low-lying plains and coastal swamps with occasional high ridges. The south-east part of Sabah, comprising the Semporna peninsula, is generally rugged and consists of steep volcanic hills. [1]

Sarawak consists of about 60 per cent of moderately undulating areas. Along the coast, low-lying swamps prevail. Away from the coast most of the areas show a gradual increase in height on the approach to the Sarawak-Indonesian border. In places, mountains rise to more than 2,500 m above sea level. [1]

2. Climate

Peninsular Malaysia is subjected to maritime influence and to the interplay of the prevailing wind systems originating from the Indian Ocean and the South China Sea. It has an equatorial climate with monsoonal influence, and is characterized by constant high temperatures, high rainfall and high humidity. The climate of Sabah and Sarawak is generally of the tropical humid type. [1]

The annual rainfall is high over the entire peninsula, averaging 2,500 mm. The east coast has an average of 3,000 mm, while the driest locality receives about 1,600 mm per year. While there is no specific dry season, the rainfall varies sufficiently at different periods in the year to justify a classification of the rainfall regime into seasons of lesser or greater rainfall. [1]

Rainfall in Sabah ranges from 4,000 mm in the coastal area to 1,500 mm per year in the interior. Sabah experiences two rainy seasons: the south-west monsoon brings rain mainly to the west coast between October and March, and the south-east monsoon brings rain to the east coast from May to August. [1]

The climate of Sarawak is characterized by regular heavy rainfall throughout the year. The mean annual rainfall in Sarawak varies from 3,050 to 4,050 mm. Most of the rainfall occurs during the north-east monsoon, which begins in October and lasts until February. During the south-west monsoon that lasts from April to August, the state receives relatively little rain. [1]

B. WATER RESOURCES

1. Surface water

(a) Rivers and Lakes

Peninsular Malaysia is drained by a dense network of rivers and streams. The year-round precipitation supports a perennial stream flow in most of the rivers. The longest river is the Pahang river, which follows a course of 434 km before reaching the South China Sea. It drains a catchment area of some 29,000 km^2. Other major rivers that also drain into the South China Sea are the Kelantan river, Trengganu river, Dungun river, Enadu river and Sedili river. The major rivers on the west coast drain into the Straits of Malacca, and these include Muda river, Perak river, Kelang river and the Muar river. In general the main streams and the major tributaries are more or less parallel or transverse to the structural grain of the country. [1]

Major rivers in East Malaysia tend to be larger than in Peninsular Malaysia, up to 51,000 km^2 (Rajang river). [2]

Sabah includes a number of permanent rivers. The largest and longest river, the Kinabatangan, follows a course of 550 km before reaching the sea. The second largest river is the Segama, which also drains the east coast just south of the Kinabatangan drainage area. Other major rivers on the east coast are the Labuk, Tungud, Sugut and Paitan, which drain the north-east part of Sabah, and Tingkayu, Kalabukan, Kalumpang and Serudang, which drain the south-east part. Major rivers on the west coast are Padas, Papar, Moyog, Tuaran and Kadamian. [1]

Rivers in Sarawak flow mainly to the north-west. In many cases, meandering rivers flowing through coastal plains have ox-bow lakes. [1]

There are about 150 river systems in Malaysia. They are small when compared to the other large rivers of the world. By virtue of its topography, the streams flowing in the upper reaches of the Malaysian rivers are swift and become slow in the lower reaches. The very gentle gradient in the west coast of Peninsular Malaysia have resulted in large extensions of tidal flats and swamps. [3] A good example of one of the swamp lakes is lake Tasek Bera in Pahang State. The surface area of this lake is 61.5 km^2. While the lake's maximum depth is 7 metres, its average depth is only 2 to 2.5 metres. [4]

Monsoonal floods occur almost every year. However, its severity, location and time of occurrences varies from year to year. The west coast of Peninsular Malaysia experiences flash floods during the inter-monsoon period when convectional storm activities are common. [3]

(b) Inland navigable waterways

Total extent: 7,296 km [5]

(c) Dams, Reservoirs and Hydropower

Number of dams higher than 15 m, by period of completion:

Until 1950:	1
1951-1977:	10
1978-1982:	1

Source: [6]

As of 1988, Malaysia had 36 dams with heights of more than 15 metres.

Large dams over 15 m in height:	36
Large dams over 30 m in height:	19
Large dams under construction:	2

Source: [5]

In 1992, there were two dams with heights of over 15 metres under construction.

Table 1. Major dams with hydro plants

Name	Year completed	River or Basin	Rated capacity now (MW)	Rated capacity planned (MW)	Maximum reservoir capacity (Mm^3)
Kenyir	1985	Trengganu	400	400	13,600
Kuala Yong (Pergau)	1996	Pergau		600	62.5

Source: [7]

Hydropower potential

Gross theoretical hydropower potential (GWh/year):
Peninsular Malaysia: 41,400
Sabah: 11,700
Sarawak: 190,000

Source: [7]

Hydropower Development

Total installed capacity (MW):
Peninsular Malaysia: 1,248 (1991)
Sarawak: 108 (1993)

Source: [7]

Total annual generation (GWh/year):
Peninsular Malaysia: 4,300 (1991)
Sarawak: 614 (1993)
S

Source: [7]

Percentage of electricity generation by hydro (%):
Peninsular Malaysia: 22
Sarawak: 30

Source: [7]

Small Hydropower

Gross theoretical small hydropower potential (GWh/year):
Peninsular Malaysia: 1,062.5
Sabah: 3,530 (preliminary figure)

Source: [7]

Exploitable small hydropower potential (GWh/year):

Peninsular Malaysia:	1,038.5
Sabah:	2,000 (preliminary figure)

Source: [7]

Small hydropower plants in operation:

Peninsular Malaysia:	No:		2
Capacity (MW):	9.7		
Sarawak:	No:	0	
Capacity (MW):	0		

Source: [7]

Mini and Micro hydropower plants in operation:

Peninsular Malaysia:	No:		0
Capacity (MW):	0		
Sarawak:	No:	7	
Capacity (MW):	2.35		

Source: [7]

2. Groundwater

(a) **Peninsular Malaysia**

Groundwater prospects may be broadly grouped into four main categories:

(i) The most promising aquifers are found in Quaternary alluvium, which may yield 25 m^3 per hour if sand or gravel horizons are present. However, in many cases the yield per well exceeds 100 m^3 per hour, as was proven in the alluvium in Kelantan and Trenggau. The alluvial aquifers on the east coast are generally extensive, both laterally and vertically, and are considered to have the highest potential for groundwater development. [1]

(ii) Carbonate rocks may also constitute important aquifers. However, their distribution is more localized. They are restricted mainly to Perlis, north Kedah, Perak, Selangor, and parts of Kelantan. Most of the productive wells are located in the karstified carbonate rocks, in particular in the Permian limestones in Perlis, where yields up to and over 65 m^3 per hour have been exploited. [1]

(iii) Areas that are underlain by complex sedimentary and volcanic rocks are of limited groundwater potential. They are important only locally in that they provide small amounts of groundwater for domestic purposes. [1]

(iv) Granitic rocks outcrop widely. In general they are of limited potential for groundwater development. Some groundwater, however, can be exploited from the weathered or fractured zones. [1]

(b) **Sabah**

The only aquifers of importance are the sandstones in the Upper Miocene sedimentary basins. The sandstone aquifers are extensive and thick and consistent in dip and strike. Individual sandstone beds could be up to 50 m thick and cover several square kilometres. The aquifers are overlain by impermeable shale or mudstone. [1]

(c) **Sarawak** (Government information)

Groundwater prospects may be broadly grouped into three categories:

(i) **Surficial Aquifers:**

These refer to those aquifers occurring within 30 m of the ground surface in areas underlain by the unconsolidated Holocene (Recent) and Pleistocene sediments of the coastal plain. They consist of shallow coastal sands, peat and the sand and gravel facies of marine and riverine alluvium.

The shallow coastal sands are generally barrier sands and some tidal channel sands that fringe a significant stretch of the coastline. These are important sources of water for the coastal communities. The development of the shallow sand aquifers takes into account that they are, in most cases, surrounded and underlain by saline water.

The marine alluvial sands are commonly found in the coastal plains. In many cases they form the "second" aquifers in the coastal fringes and are generally confined. The riverine alluvium are extensive in the upper reaches of the deltas; the sands and gravels in this alluvium are in direct contact with the rivers and are suitable for bank-infiltration schemes for drawing large volumes of water for urban supplies.

Peat underlies about 2 million hectares of the coastal plain, and more than 50 per cent of these peat have thickness greater than 3 m. It holds a very large volume of water in storage, estimated at greater than $2.24 \times 10^{10} m^3$. The ground-water from the peat sustains the rivers and streams flowing out of the peat swamps during the dry seasons, and these are important sources of water for the more than 20 coastal water supplies that caters for nearly 100,000 people.

(ii) **Deep Aquifers in Sedimentary Basins:**

Several major sedimentary basins with groundwater potential occur in Sarawak and notable among these are the rock formations in northeast Sarawak. The formations include the Tukau, Lambir, Miri, Liang and Belait Formations. The

flow characteristics in these formations are dominated by porous flow. Groundwater is presently withdrawn from the Tukau Formation as a supplementary source for the Miri Water Supply. A typical well located in the sandy facies of this formation yields up to 3,000 kilolitres per day of water; the wells located in the clay (tidal) facies yield between 1,000-2,000 kilolitres per day.

The noteworthy sedimentary formation with dominant porous flow in central Sarawak is the sandy facies of the Nyalau formation in the Nanga Merit region. In west Sarawak, thick friable sandstone layers have been encountered in the Silantek Formation and these have in some instances been exploited for groundwater.

Deep aquifers are also found in Quaternary sediments in the coastal plains of Sarawak. The hydrogeology of these sediments is complex and based on the exploratory boreholes drilled, some to depths of 160 m at Kuala Baram, Kuala Tatau, Balingian, Mukah, Oya, the Rajang Delta and Asajaya, the probability of locating extensive freshwater aquifers in these sediments in the near-shore areas is limited.

(iii) **Fractured Rock Aquifers:**

Fractured rocks occupy more than half the state of Sarawak. The aquifers in these rocks are seldom extensive and normally only locally important. Their yields, except in limestone areas, are also usually smaller than the other aquifer types. Many wells are tapping water from the fractured rocks; in the Kayan Sandstone at Matang the wells have yields ranging from 150-250 m^3 per day. The wells in the indurated shale-sandstone sequences of the Pedawan Formation have yields of between 35-360 m^3 per day. Those boreholes penetrating the limestone lenses of this formation have significantly larger yields. One of the characteristic structural features of the rocks of the Serin Arkose Member of the Sadong Formation is the fine, closely-spaced joints. Wells located in this rock formation have consistently yielded volumes between 210-345 m^3 per day.

Fractured rock aquifers offer further scope for the development of groundwater in Sarawak, especially low to moderate yields for domestic, agricultural and industrial water requirements in the rural areas.

C. WATER QUALITY AND WATER POLLUTION

1. Surface water quality

Water quality is deteriorating badly in many rivers because of economic development, logging, urban effluent, etc. [2]

Generally the quality of rivers in Malaysia has been good, except where they pass near populated areas where they get polluted. Contributing factors to raw water pollution in Malaysia have been identified as follows:

From the point of view of raw water quality, the principal contributory factors to pollution of the water have been mainly due to:

(i) Soil erosion and stream siltation during changes in land use, caused by deforestation for agriculture/oil palm development, has created tremendous ecological changes in the rivers basins' water quality and also the depletion of dry-weather flows;

(ii) Development of agro-based industries, e.g. palm oil mills, rubber factories etc., has caused discharge of effluents. Although governed by legislation, this has contributed to degradation of streams, e.g. low dissolved oxygen, high dissolved solids from palm oil wastes, pesticides and herbicides dus to pest control usage in the plantations, nutrients from fertilizers and oil/grease from palm oil wastes;

(iii) Development of townships with no proper sullage and sewage treatment, although most of the new townships are provided with pour-flush latrines/septic tanks, but with no adequate soakaway pits. This has caused discharge of waste water flows high in BOD and suspended solids. [8]

The licencing of prescribed premises (mills and raw natural rubber factories) has proved in significantly reducing BOD load over the past 16 years since the regulations came into force. The percentage of BOD load reduction increased from 70 to 99 per cent from 1978 to 1982 and it is maintained from 1982 onwards at approximately 99 per cent. To date only 10 per cent of total organic pollution could be attributed to both agro-based and manufacturing industries and 90 per cent is from the domestic and animal wastes. In terms of actual loading, it has been estimated that on the average the agro-based industries are generating some 28 tonnes per day of BOD load. (Government information)

2. Groundwater quality

In Peninsular Malaysia, the quality of the groundwater is largely dependent on the geological environment in which it is found. Shallow groundwater is widely used by the rural population, and is chemically acceptable for most uses except on occasions when the iron content may be higher than desirable. On the other hand, some local bacteriological pollution may be present. Deeper groundwater, while presumably free from bacteriological contamination, usually has a high iron content also. Water from sedimentary terrain is usually safe for drinking after minimal treatment. Groundwater from granitic areas is usually suitable for various uses. [1]

The groundwater in Sabah, from Sandakan and Labuan is of good quality, clear and odourless. Solids are mainly inorganic salts (sodium chloride). Some faecal pollutants are encountered in Sandakan.[9]

In Sarawak, the groundwater in the surficial aquifers generally requires treatment to remove iron and manganese except along some narrow strips of higher beach ridges. The quality of the groundwater is also influenced by connate waters and by the inflow of water from the adjacent formations, principally the peat and the underlying marine clays, which contribute to the increased colour, salinity and odour of the groundwater. In the case where water is drawn directly from the peat aquifer, the water generally requires treatment to remove the colour, iron and acidity.

The quality of water in the Tukau Formation is of low salinity and neat neutral pH; the values of iron and manganese are, however, slightly elevated. Similar quality water can be expected from the other deep sedimentary rock formatins in northeast, central and west Sarawak. The deep aquifers in the Quaternary sediments in the coastal fringes are characterised by moderate to high salinity water with high iron and manganese values.

The quality of water from the fractured rock aquifers are good except that the iron values are just slightly higher than the WHO maximum permissible level.

In most cases groundwater used for the major municipal water supply schemes is of acceptable quality, and the raw water is amenable to conventional treatment processes. [10]

While deeper aquifers are relatively safe from contamination from human activities, the shallow aquifers are more vulnerable, particularly in well fields within areas of high population density and industrial development. in the past there have been isolated reports of groundwater degradation due to indiscriminate industrial effluent discharge in which shallow wells were affected. However, such cases are not very common and usually of a localized nature. [10]

Groundwater deterioration owing to human activities remains at a manageable level at present. However, because of increasing urbanization and industrialization, as well as intensified agricultural practices and increased groundwater abstraction rates to meet higher demand, the problems of water quality degradation can be expected to rise. Particularly vulnerable will be areas with shallow unconfined aquifers such as in the Kota Bharu area, or in the heavily industrialized Klang Valley in Selangor at Peninsular Malaysia. [10]

D. WATER AVAILABILITY PATTERNS

Malaysia receives an annual average of more than 2,500 mm rainfall, mainly due to the Southwest and Northeast monsoons. The country is therefore rich in water resources when compared to other regions of the world. The above average annual rainfall, when translated into volumetric quantities on the total land area of the country, leads to a total of water resources of some 990 km^3 per year. Out of the above total resources, it is estimated that some 360 km^3 (or 36 per cent) return to the atmosphere as a result of evapotranspiration, 566 km^3 (or 57 per cent) appear as surface runoff, while the remaining 64 km^3 (or 7 per cent) contribute to the recharging of the aquifers. [11]

Annual Renewable Water Resources

Annual internal renewable water resources:	566.0 km^3	[12]
Exploitable groundwater potential:	23.2 km^3/year	[4]
Annual renewable water resources per capita (1990):	31,851 m^3/year	[12]

E. WATER USE PATTERNS

1. Water Use by User Sector:

Annual water withdrawal (1990):	Total:	11.6 km^3 [12], [11]
	Per capita:	653 m^3 [12]
	Domestic:	10 per cent [12]
	Industry:	13 per cent [12]
	Agriculture:	77 per cent [12]

(a) Domestic Water Use

Public water supply serves the majority of the population. Urban systems are often overloaded, and rural supplies experience difficulty in access to water sources. [2]

Water supply and sanitation

Table 2. Urban and rural water supply

Coverage	1980		1990	
	Urban	Rural	Urban	Rural
Population covered (thousands)	4,130	4,370	7,025	7,090
Percentage of Total	90	49	96	66

Source: [13] and [14]

Table 3. Urban and rural sanitation

Coverage	1980		1990	
	Urban	Rural	Urban	Rural
Population covered (thousands)	4,595	4,850	6,857	10,019
Percentage of Total	100	55	94	94

Source: [13] and [14]

Urban water supply and use:

Water supplied by water utilities:

City:	Kuala Lumpur	Penang
Population:	1,145,075 (1991)	1,200,000 (1992)
Population served:	1,145,075	1,232,042
Av. daily production:	360,000	500,000 m^3/d
Groundwater:	0 per cent	0 per cent
Surface water:	100 per cent	100 per cent
Annual water use:	131.4	182.5 Mm^3
Per capita consumption:	222 l/c/d	203 l/c/d
Domestic:	32 per cent	50 per cent
Industrial/Commercial:	21 per cent	28 per cent
Other:	10 per cent	0 per cent
Unaccounted for water:	37 per cent	22 per cent

Source: [15]

(b) Agricultural Water Use

Almost all of the irrigation schemes utilize surface water. Use of groundwater is negligible. [16]

Irrigated area (1,000 ha):

Year:	1970	1975	1980	1985	1990
Irrigated land:	262	308	320	334	342

Source: [5], [17]

Average annual growth of irrigated land (1980-1990) was 0.7 per cent.

2. Water Use by Source

Groundwater supply: 25 per cent
Surface water supply: 75 per cent

Source: [10]

(a) Surface water

The existing piped water supply schemes are, with a few exceptions, using surface water sources. [1] Almost all of the irrigated lands utilize surface water sources. Similarly, industry uses more surface water than groundwater.

(b) Groundwater

Groundwater utilization:

Domestic and/or Municipal:	60 - 65 per cent
Irrigation:	5 per cent
Industry:	30 - 35 per cent

Sources: [4], [10], [16]

In Peninsular Malaysia, groundwater is utilized mainly for domestic supplies, with lesser amounts developed for industrial needs. Groundwater is not used significantly for agriculture. [1]

Groundwater is developed for domestic purposes mainly in rural areas, largely from driven or dug wells. More than half of the rural population rely on shallow wells for their water supply. [1]

Municipal water supply systems in several large towns in Kelantan, namely Kota Bharu, Tumpat, Pengkalan Cepa, Tanjong Mas and Bachok are dependent on groundwater sources. In Sabah, the major towns, Sandakan and Labuan, depend partly on groundwater. Several industries in these two towns draw their supplies from groundwater sources. In Sarawak, the use of groundwater is not very extensive.

Groundwater is also being used for agricultural purposes. The Department of Irrigation and Drainage has initiated several schemes in Kelantan in which groundwater is used conjunctively for irrigation purposes. Groundwater has also been used on a limited scale for aquaculture. [10]

Industrial use of groundwater is concentrated mainly in the major industrialized zones, such as the Klang Valley, in Selangor. [10]

F. WATER DEMAND PROJECTIONS

The total water requirement for the year 2000 was estimated as 14.2 km^3, considering a 2.3 per cent increase in population per year, on the average 11 per cent increase per year in industrial water demand, and 0.7 per cent in irrigation water demand between 1990-2000. The domestic/ municipal demand would be 10 per cent, industry 22 per cent, and irrigation 67 per cent of the total water demand in the year 2000. [9], [17], [18], [19]

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ACTIVITIES OF THE UNITED NATIONS SYSTEM IN THE FIELD OF WATER AND MINERAL RESOURCES, AND INTER-AGENCY COORDINATION FOCUSING ON PROGRESS MADE TOWARDS ACHIEVING SUSTAINABLE DEVELOPMENT

Activities of the Economic Commission for Africa in the area of water resources

Note by the Secretary-General

The report of the Economic Commission for Africa in the area of water resources, available in the language of submission, is contained in the annex below.

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Annex

REPORT OF THE ECONOMIC COMMISSION FOR AFRICA ON ITS ACTIVITIES IN THE AREA OF WATER RESOURCES

I. WATER RESOURCES SECTOR

1. ECA programme for development, management, conservation and utilization of water resources, places emphasis on assisting member States in the areas of formulation of their national plans, policies , strategies and capacity building. Assistance is extended to sub-regional and regional intergovernmental organizations in the African region. Assistance is also directed to the promotion of inter-country and sub-regional cooperation and the strengthening of national and sub-regional capacities for the exploration, exploitation and management of water resources in a sustainable manner.

2. Towards achieving the above goals the following activities were undertaken during the biennium 1994-1995.

(i) Cooperation and liaison with international, regional and sub-regional, inter-governmental and non-governmental organizations on activities related to water resources assessment, development and management in order to avoid duplication and overlapping of activities. In this regard consultations and exchange of information on water activities leading to joint implementation of projects with other UN system organizations.

(ii) An ad-hoc group meeting on policies and strategies for development of natural resources including water and energy was organized with a view to recommending specific policies and strategies to address the issues of natural resources and energy development in Africa.

(iii) A recurrent annual information bulletin on water resources in Africa was published to disseminate information and enhance exchange of experience on water development activities.

(iv) Studies were published on: a) procedures, practices, problems and prospects for small-scale irrigation systems in selected African countries, b) marine pollution problems and strategies for inter-country cooperation in alleviating those problems in line with the objectives of Agenda 21, c) problems related to sustainable development and utilization of natural resources and energy strategies for inter-country cooperation in the context of Agenda 21. The purposes of the above activities was to make an in-depth study on specific areas to provide solutions and make recommendations within the context of Agenda 21.

(v) Provision of information and services in the form of charts and posters to enhance awareness on the need for water resources conservation, management and utilization.

(vi) Advisory services and technical assistance for the development and management of

transboundary basins in Africa to strengthen existing organizations and to assist in the establishment of new ones where necessary. These activities were geared to lead to inter-country cooperation and to realize the objectives of integrated and holistic water resources planning, development and management.

(vii) Organizing the servicing group training including seminars and workshops for sustainable development of water resources in order to strengthen capacity building at the national and sub-regional levels.

(viii) Organizing and servicing the annual sessions of the Inter-Agency Group for water in Africa (AGWA) to promote coordination, and joint implementation of water activities in Africa. The group also promotes joint implementation of projects by member agencies in Africa. In March 1995, ECA and WMO jointly organized in Addis Ababa, a conference on Water Resources Assessment, Development and Management during which ECA presented a paper on the "Role of Water Scarcity and Water Stress in Addressing the Economic Challenges facing African Countries at the Dawn of the 21st Century."

3. ECA participated actively in a workshop organized by IAEA in April 1995 on isotopes technology for water resources assessment in Africa. It collaborated with UNEP in organizing an expert group meeting on the implications of Agenda 21 for integrated water management in Africa. Under a joint programming arrangement with DDSMS, ECA is planning to organize a training on groundwater software utilization.

4. At the request of the Inter-Agency Group for Water in Africa (AGWA), ECA is preparing a project document on integrated management of transboundary fresh water resources in Africa. It will analyze and diagnose possible solutions to the problems and constraints limiting cooperation on transboundary river/lake/groundwater basin development, and to promote coordination among riparian countries. The initial implementation of the project will be the organization by ECA and other interested UN agencies of an international conference in 1996.

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Annex

REPORT OF THE ECONOMIC COMMISSION FOR EUROPE IN THE AREA OF WATER RESOURCES

Overview of Transboundary Watercourse and International Lakes in UN/ECE Countries

The extent of the economic and environmental relevance of transboundary watercourses and lakes and rivers is clearly demonstrated by the magnitude of these resources and the boundaries through which water flows. In fact, more than 50% of the thirty-one major river basins in Europe with a drainage area of over 50,000 km^2 have transboundary catchments. Moreover, a great number of small and medium-sized waters crisscross the boundaries between two or more states. For centuries, water has played an important economic role in these catchment areas in Europe without particular thought being given to the notion of preventing, controlling and reducing transboundary impacts.

The long history of water-construction works has led to a situation where most transboundary waters in Europe are heavily regulated and hence are far from their pristine conditions. The effects of river regulation are not just felt locally and there is often an impact on downstream and surrounding areas. The impact has led to conflicts between various uses including conflicts between riparian countries. Concern over the severeness of flood events, particularly as a consequence of man-made alterations of river banks, river beds and floodplain, is also growing.

Water use by industry and agriculture also threaten water quality, fisheries, shore use or the balance of ecosystems. The pollution of transboundary watercourses and international lakes has become a widespread phenomenon in Europe and a matter of particular concern. Freshwater supply in European countries is often dependent upon such external sources, in the Netherlands, for example, two-thirds of the water supply depends on the Rhine.

It appears from submissions to the ECE secretariat that organic pollution is considered a serious problem for the rivers Danube, Daugava, Dniepr, Elbe, Meuse and Scheldt. The bacteriological quality of some transboundary rivers in Europe, although improving, is low. Algal growth in transboundary surface waters is a major problem in parts of Europe as a result of pollution from agricultural sources. Trends in pollution by heavy metals and other toxic substances are not very encouraging either. For example, critical values of cadmium concentration are exceeded in the Rivers Danube, Dniepr, Elbe, Neisse and Oder. High levels of DDT have been detected in the River Oder. Although only limited results of water quality measurements in transboundary waters are available, it may be concluded that these, like many internal groundwaters, experience nitrate concentrations above drinking water standards and show signs of contamination of heavy metals, metalloids and pesticides.

To enhance the protection of waters and reduce transboundary impact requires reliable data. There are signs that the availability of water quality and water quantity data in Europe is improving, and progress is being made in the introduction and use of harmonized collection methods and a broadened exchange of information. Examples at the subregional level include activities of joint bodies, for example, those established for the rivers Danube (at interim) Elbe, Oder (at interim) Rhine and the Finnish-Russian waters, and the lakes Constance and Geneva. At the regional level the situation is quite different. Data availability is still inadequate and requires joint efforts under the Water Convention in order to avoid piecemeal solutions to serious

problems. The same applies to data on the status of water treatment facilities in transboundary catchment areas, where at the regional level only sporadic information is available on the status of sewer networks (number, type and capacity of waste water treatment plants) and methods of sewage sludge treatment and disposal is available. In all likelihood this impedes the planning of assistance to countries in transition.

National strategies

A number of ECE countries have defined national strategies with respect to the protection and use of water resources and are in the course of drawing up their strategies to respond to the objectives of the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes. While the strategies vary from country to country, there is a common thread throughout them. Many of the countries have expressed the need to limit waste water emissions and to undertake comprehensive water quality measures. In addition to these needs, there is agreement on the precautionary and polluter-pays principle. In most cases, however, the strategies are presented in very general terms without quantifiable goals and objectives. An exception to this is the strategy in the Netherlands whereby the primary objectives is to achieve a water quality comparable to what it was in the 1930s. The strategy is defined in such a way as to present specific goals to be achieved, e.g. a 50% reduction in emissions by 1995 compared to 1985, with further reductions after 1995. It appears that the driving force for these elaborated national strategies are the international conventions such as the North Sea and the Baltic Sea.

At the same time that emphasis is given to these areas, there is a widely acknowledged concern of the need to achieve sustainability of water resources. Many countries have developed broad strategies to promote sustainable water management taking into account transboundary waters. Such strategies attempt to cover in an integrated way quality and quantity aspects of the management of surface waters and groundwaters, as well as the ecosystems. While noting the necessity to promote sustainability of water resources, within the context of national strategies, sustainability is most often presented in general terms as a goal. Sustainability is something to aim for, however, it is most difficult to achieve.

Control of point sources

Progress has been achieved in Europe in the development and application of waste water treatment and sanitation technology, the establishment of appropriate design standards, and the adoption of restrictive discharge authorization procedures. Total volumetric discharges of effluent have been cut by introducing in-plant measures and modifying production processes. From the regulatory point of view, discharge-oriented control based on technological requirements is applied in a wide variety of industries. For new industrial plants, the application of best available technology is frequently required to achieve maximum pollution prevention together with an optimum degree of safety.

In France, these measures require substantial financial resources, for example, a financial

programme on water covering the 1992-1996 period was adopted in 1991. Of a total of US$ 13.5 billion, some US$ 9 billion will be spent on reduction of pollution from point sources in the municipal and industrial sectors. Some 80 per cent of this latter amount will go to the construction or upgrading of municipal sewer networks and treatment plants, whereas the remaining 20 per cent is foreseen for the reduction of pollution from industries. These sums are roughly double the amounts spent for the same purposes in the 1986-1991 period.

Most central and eastern European countries suffer the consequences of past developments. Industrial waste waters are frequently discharged into the sewer network or directly into the recipients without any proper pre treatment. Moreover, a great number of the public treatment plants in central and eastern Europe are only mechanical-biological plants. Treatment plants are often overloaded, improperly operated and use inappropriate treatment technologies. The degree to which the load of pollutants is reduced is therefore often smaller than expected.

Not withstanding progress already made and planned measures in countries in transition there are several issues to be raised. For example, while limits are set for emissions, are these in fact realistic taking into account the benefits arising from decreased pollution and the costs associated with achieving these benefits involved. Many countries lack funds for the construction of waste water treatment plants, and a prudent approach could well be that no new plants are built until one can assure adequate treatment of waste water prior to discharge into sewer systems or receiving waters. Such a policy is already practiced in some countries. There is always the question of upgrading existing treatment plants or constructing new ones. A complete examination of alternatives is clearly required prior to approval of new construction. If waste water is treated prior to disposal into sewer systems, then clearly there is less need for new construction and greater justification for upgrading of existing facilities. The polluter-pays principle must be strictly enforced.

Attention should be directed towards the concept of Best Available Technology. ECE countries have repeatedly made reference to the adoption of BAT. The Convention on Transboundary Waters includes in Annex 1, a definition of the term best available technology. This definition is taken to mean the latest stage of development processes, facilities or methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. The definition takes note, that among many factors, special consideration must be given to the economic feasibility of such technology. The importance given to economic feasibility is in direct contrast to the position adopted in Germany. In the latter case, the German Federal Water Act gives greater weight to ecological concerns than to the economic feasibility of such technology.

Control of non-point sources

Various measures have been taken in Europe to decrease pollution from non-point sources in agriculture. Their ultimate goal is to ensure that the total amount of nutrients applied to farmland, including chemical fertilizers, manure, slurry and urine, does not exceed the amount

taken up by crops.

Many widely-used pesticides have been classified as a potentially high risk for leaching into groundwaters, and have accordingly been phased out in some European countries. Action programmes aimed at reducing pesticide use by up to 50 per cent have been drawn up, for example, in Denmark and Sweden. France has developed a particular action programme for the protection of waters against pollution by pesticides. Only a limited number of pesticides are licensed in this country for the control of weeds in water bodies. There are strict conditions for their use, such as a limited time period of application or application on dry ditches only. In some other countries, such as Denmark and Germany, there is already a complete ban on the use of pesticides for these purposes. Such a ban is also under consideration in the Netherlands.

Codes of good agricultural practice have been elaborated in some European countries to reduce water pollution by fertilizers and pesticides. They serve as a new form of direct advice to farmers with emphasis on fertilizer use, plant cultivation, reduction in soil erosion and the revised draft guidelines on the prevention and control of water pollution from fertilizers and pesticides will assist ECE governments in implementing plans, practices and other measures. Agricultural policies should be promoted to combine the application of strict legal and regulatory measures and appropriate economic instruments.

With respect to non-point sources of pollution, governments have a tendency to concentrate upon agriculture which leads to the most severe pollution and place minimal attention upon other sources of pollution. Guidelines for agriculture have been adequately defined and it is necessary to strictly enforce them. The situation regarding the other sources of pollution is far less clear. Much more work remains to be done on detecting leakages of polluting substances from existing and disused underground storage sites and from abandoned waste disposal sites. Work should be undertaken to examine existing technology for lead detection and for the development of new technology. Technical measures should be evaluated for the prevention and effective containment of accidental spillage from highways, railways and during pipeline transportation. Cost effective rehabilitation measures are needed to prevent groundwater pollution from the rehabilitation of abandoned military sites. In furtherance of the need to promote the convergence of national policies and strategies to prevent and control groundwater pollution, and as an initial endeavor, ECE organized a seminar on this subject in Madrid, Spain from 11/15 September 1995. In addition.to providing a platform to share experiences on chemical storage facilities and waste disposal sites. the participants also focused their attention upon the decommissioning of industrial and military sites. This subject is of increasing concern as the process of dismantling military sites proceeds and the effects of pollution become widely disseminated to the public at large. The immensity of future problems is illustrated by the simple fact that the Federal Republic of Germany a surface of approximately 1 million ha had been used for military purposes up to 1990. The dismantling of military sites is of increasing concern throughout developed and developing countries. Guidelines needed to provide advise on such matters as the establishment of inventories of old production sites and other contaminated areas, the detailed evaluation of areas polluted by hazardous substances, and setting priorities for rehabilitation. Another serious problem is saltwater intrusion from over-

exploitation of aquifers and attention should be directed towards the conjunctive use of groundwater and surface water.

Contingency planning

While most industrial accidents that could potentially adversely affect water quality can be contained within the boundaries of the industrial plant, there are cases where impact extends beyond these boundaries and has adverse effects, both short-term and long-term, on life, life-support systems including water, or property. Groundwater pollution has severe consequence and ever-increasing attention is being given to the operation and monitoring of chemical storage facilities and waste/disposal sites.

Contingency planning is most important in view of the apparent degree of unpreparedness at local, national and international levels. With respect to industrial accidents one is fortunate to have the ECE Convention on the Transboundary Effects of Industrial Accidents. This Convention provides the necessary mechanism to strengthen cooperation at the regional level to strive for consistency, set up joint contingency plans and harmonize relevant procedures, particularly in a transboundary context. In contrast, the Water Convention does not go into much detail regarding emergency preparedness and contingency planning. However, in a number of European countries, water act or accidents ordinances have introduced a system of preventive action, directly related to facilities, to avoid hazardous incidents and accidents. Owners of industrial facilities dealing with large quantities of hazardous substances are often required by law to meet certain safety standards. In particular, they must carry out risk analysis, implement monitoring and control systems and plan detailed emergency measures. Individual plans have often to be approved by the provincial or local water inspectorate. Water-management authorities have to regularly check the status of such measures and the compliance with legal regulations. Contingency systems and guidelines for a safe drinking-water supply in the municipalities are also being developed.

Economic and financial instruments

Economic and financial instruments are widely used in European countries as a complement to other policy instruments. Their basic objective is to ensure the appropriate pricing of water resources and water-related services in order to promote an efficient use and allocation of these resources. Charges, levies and fees for abstractions and discharges are intended to promote both the rational use of water and the control of pollution in accordance with the polluter-pays principle.

The most common and prevalent economic measure to control and reduce pollution is the principle that the polluters must pay for pollution. This principle has been adopted, with varying degrees of success, by all ECE countries. As one would expect the method of determining taxes and use of such revenues varies from country to country. The differences in rates of taxation and ultimate use of revenue greatly determine the effectiveness of the polluter pays principle.

In order for taxes to be an effective incentive against pollution, penalties must be set at high enough levels to make it costly to continue the ways of the past. From a technological point it is not difficult to determine pollution limits which must not be exceeded and the tax should be greater than the treatment cost. As an example, the Government of Croatia is well aware of the need of the level of taxes necessary to control pollution. However, due to the present situation and state of industry, they had to set a fairly low level of tax of some DM 0.16 for each cubic metre of waste water. In this particular case, the general economic conditions of the country prevent the application of an effective polluter- pays policy. The ability to enforce tax levies is also of paramount importance. In Hungary the law states that noncompliance by dischargers can lead to the cessation of activity, however, this has happened in very few cases.

An important element in economic policy is how the funds collected from polluters are utilized. Funds may either be utilized to control pollution and improve the environment or for general expenses of the government. While the Croatian government collects limited taxes, all revenues do go to the Croatian water management authorities and must be used for waste water management purposes. In France pollution charges are collected by the Water Agency and can only be used for measures such as subsidies for pollution control measures and the restoration of the quality of inland waters. In contrast, the Government of Slovenia's policy is that revenue from taxes and charges are transferred to the general state budget.

Sustainable water management

In this context, the objectives of water management are broadened to cover the utilization and development of water resources in an efficient, environmentally sound, equitable and reasonable manner in order to satisfy society's demand for water, water-related goods and services, as well as to safeguard the ecological functions of water resources. Specific policy instruments applied in Europe to promote sustainable water management include environmental impact assessment, integrated planning and the application of the ecosystem approach.

Proposed activities in a catchment area that could adversely affect the conditions of aquatic ecosystems in terms of water quality and quantity, biological communities and the integrity of aquatic ecosystems, are already subject to an environmental impact assessment (EIA) in some European countries. Frequently, EIA is required for such water-related investments as hydropower projects, dock constructions and large dredging activities. Other examples include the establishment, removal or substantial modification of a water body or its banks and the construction of dykes and dams; the expansion, construction or removal of a federal waterway; and the construction and operation or the substantial modification of waste-water facilities with a certain minimum capacity. Water abstraction is also subject to an EIA in some countries, if the intake is on transboundary waters or water is abstracted in significant amounts from other groundwaters and surface waters. Non-water-management activities which may have an adverse impact on water resources are also subject to an EIA in some countries. These include, for example, the construction of oil and gas pipelines, opencast mining and sludge-storage areas.

The integrated planning of water resources seeks to include socio-economic,

environmental and technical aspects into a decision-making framework. This how it can take into account all short-term and log-term needs and effects, ensure users' interests while maintaining ecosystem integrity and biological diversity, and find an appropriate balance between conflicting interests, on the national and transboundary level. The ecosystem approach to water management is essential for achieving and maintaining sustainability. It takes a broad, holistic view of the interaction among physical, chemical and biological components within a catchment area. The ecosystem approach covers the entire system comprising water, land, air, flora and fauna.

The entire subject of sustainable water and integrated water resources management needs much greater elaboration. There are indeed major policy decisions needed to be undertaken to bring these concepts to reality. Integrated water resources management involves a multi-sectoral approach taking into account not only water resources but also economic and social sectors of economies. Alternative uses of water have direct consequences upon a multitude of sectors and integrated water resources management involves determining the relationships between the sectors. The very concept of integrated water resources management involves determining the relationships between the sectors. The very concept of integrated water resources management implies a significant contribution in terms of capital and human resources and the development of a model to quantify results. The successful application of integrated water resources management necessitates accessibility to an extensive data base and the development of a macro-economic model. The model should present planners with an array of outputs based upon different scenarios. In order to demonstrate inputs and complexity of such a task it is suggested that a pilot project be undertaken which could serve as a guideline to methodology and application of integrated water resource management. What is important is the development of the methodology, which then could be applied throughout the ECE countries.